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FAMILY STUDIES IN THE EASTERN HEALTH DISTRICT

III. A CONSIDERATION OF ISSUES INVOLVED IN DETERMINING MIGRATION RATES FOR FAMILIES[1, 2]

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GENERAL DISCUSSION

EARLY treatments of migration dealt primarily with mass movements by which whole peoples or large segments of them shifted from one geographical area to another. In modern times, with the growing ease of transportation, stress on specialization of industry, and other changing forces, the movement of people, as individuals or as family units, within their native boundaries has increased rapidly. The result is that internal migration, as this movement is called, has become of vital importance as a complex part of the population problem.

The present paper discusses some general issues important to any consideration of internal migration, such as the fundamental problems

[1] Acknowledgement is made to the Milbank Memorial Fund for support of the Fellowship under which this work was done, and also to the Milbank Memorial Fund and to the U. S. Public Health Service for the use of material obtained in the morbidity study carried out jointly by these two agencies.

[2] From the Department of Biostatistics, The Johns Hopkins University School of Hygiene and Public Health, Paper No. 220.

of definition, methods of securing observations, and the choice of rates useful in describing migration. The usual method of obtaining migration estimates from two separate censuses of a given area is illustrated and, in addition, an analysis is made of material obtained by continuous observation of an area.

As the mobility of individuals within a population unit has become more pronounced, the need for estimates of its magnitude, causes, and direction has been felt by many organizations and by the student of population problems in general. A large number of investigations has been carried through to meet this need, directed primarily at specific questions of concern to the particular agency or individual. The limitation of these studies is no objection, however, for it is probable that a complex problem is best attacked by well-directed specific questions. But the fact that these studies are directed at different aspects of the problem means that the term "migration" is used in widely different senses. Consquently, there rests upon the investigator a responsibility for precise statement and definition.

If the term "migration" is accepted as a general one implying simply a change of location or a move, then any specific migration inquiry must adequately define the subject of the migration, that is, the identifiable entity whose migration is under scrutiny, and the nature of the migration, that is, what the minimum move must be before a migration is considered to have occurred.

When the fundamental problem of definition is settled, there still remains the question of selecting the population to be observed. Theoretically, two possibilities are open, either a particular group of units (subjects) may be followed for the duration of the study or a particular area may be observed, and the migration presented by the shifting population of this area may be examined. If the former group is to be observed, the identification of the individual units is required as well as their continuous observation, except under unusual circumstances. Individual identification may or may not be present for meaningful studies based on areas, and continuous observation is more easily dispensed with in area studies.

Migration rates of a group of subjects and migration rates for an area do not mean the same thing. For short time studies their meanings may not differ greatly if there are continuous observation and individual identification in each case, but the difference in interpreta-

tion increases with the length of the study. Results using either source alone for a population are really incomplete and, ideally, a combination of the two is desired. The procedures of collecting population data in the United States make this a practical impossibility at present.

Studies may be found using either approach for obtaining a population. Those following the migration of a particular group of individuals are usually retrospective and for a select class. More numerous and probably of more general interpretation are the studies based on areas. These area studies are found to differ from one another in the continuity of observation and in the presence or absence of an identification of the units migrating. Examples will be given in the present paper of area studies using individual identification, but before turning to these examples a word will be said regarding the rates pertinent for summarizing information on migration.

Most, if not all, migration rates may be considered for convenience to belong to one or the other of two general kinds of rates. One kind of rate is a true *incidence rate*. It attempts to state how many moves (of the sort defined as migration in a particular problem) occur for a given sized population within a particular unit of time. For this rate, continuous observation of the population is required.

The other kind of rate states the proportion of the population which has not migrated for a specific period of time and so will be called a *non-migration rate*. It is strictly analogous to the survivorship rate of the ordinary life table. This figure does not require continuous observation, but it should be pointed out that when such a figure is obtained not by continuous observations but by two observations separated by the interval of time under question, the non-migration rate may be overestimated. This is because an individual who leaves and returns to his original residence between two observations will be undetected. The magnitude of the error thus introduced varies with the size of the minimum move selected as defining a migration and with the length of the interval separating the observations. What really is obtained by two separated enumerations is a *net non-migration rate*.

Because of the difficulty of continuous observation, this net non-migration rate or some related rate is usually obtained. Frequently the net non-migration rate is not mentioned explicitly, but the difference between it and unity is taken as a *minimum migration rate*. This is

a minimum rate, not only because the net non-migration rate is overestimated, but also because migration into and out of the defined area occurring completely between the observations is not recorded. Thus, quite aside from the overstatement of the non-migration rate, the resulting migration rate probably would be underestimated.

The rates mentioned above require that the subjects of the migration be identified. Crude rates of obvious value are frequently obtained without this requirement and of necessity are net rates of some form. A common procedure is to examine two separate census counts for an area and take the difference as an estimate of net migration, allowance having been made for natural increase (i. e. for the effect of the prevailing birth and death rates). There are many variations and refinements of this method, but examples of these will not be presented here.

MIGRATION RATES IN THE EASTERN HEALTH DISTRICT

An unusual opportunity for the examination of migration within an area is presented by the data collected in a series of censuses and studies regarding the population of the Eastern Health District of Baltimore. Four special surveys have been made of this area. In each, the unit of enumeration was the household or family, but, as essential to the description of these units, a roster of the membership of each family was obtained. The censuses are described in some detail by Reed, Fales, and Badger [1] in another paper. Making use of this census material, Valaoras,[2] Crosby,[3] and Phair,[4] each made an

[1] Reed, Lowell J., W. Thurber Fales and George F. Badger. Family studies in the Eastern Health District. I. General characteristics of the population. *Amer. J. Hyg.*, 37: 37-52, 1943.

[2] Valaoras, V. G. A Comparison of Two Groups of Urban Families Which Differ as to the Permanence of Their Residence. Thesis submitted for degree of Doctor of Public Health, School of Hygiene and Public Health, The Johns Hopkins University, May, 1936.

[3] Crosby, E. L. Syphilis in the Eastern Health District in 1932. The Characteristics of the Families in Which a Case of Syphilis Occurred. Thesis submitted for degree of Doctor of Public Health, School of Hygiene and Public Health, The Johns Hopkins University, May, 1937.

[4] Phair, J. J. The Selection of Tuberculosis in the Eastern Health District. Thesis submitted for degree of Doctor of Public Health, School of Hygiene and Public Health, The Johns Hopkins University, May, 1938.

estimate of the rate of migration in the Eastern Health District as a subsidiary problem to special studies in which they were engaged. Their estimates will be recognized as fundamentally related to the net non-migration rate, previously mentioned. Following a description of these estimates, an attempt to derive the true incidence rate of migration will be made using data collected in connection with an illness survey of the District which extended over a three-year period.

Valaoras made use of the 1922 and 1933 Eastern Health District censuses. The 1922 census was a survey of Ward 7 only, the 1933 census was of Wards 6 and 7, that is, of what was then the entire Eastern Health District. Families of the 1933 census were divided into two groups, those present at both censuses, called "settled" families, and those present only at the census of 1933, called "unsettled" families. As Valaoras explains, "it was decided . . . . to make individual identification the basis of family identification, and any family in which some member was present at both censuses, was counted as a family present at both censuses, even though some members were not present in 1922, or even if the family unit was not established at that time." This method was carried out for the Ward 7 population of the 1933 census and, in addition, there were included among the "settled" families, those which were present in Ward 7 at the 1922 census and in Ward 6 at the 1933 census. Table 1 shows the classification of families thus set up.

TABLE 1

Number and per cent of "settled" and unsettled" families, Eastern Health District, 1933

FAMILIES	NUMBER			PER CENT	
	White	Colored	Total	White	Colored
Present both censuses ("settled")	2,817	401	3,218	52.1	21.6
Not present in 1922 ("unsettled")	2,591	1,456	4,047	47.9	78.4
Total	5,408	1,857	7,265	100.00	100.00

By dividing the per cent "unsettled" by the number of years separating the two censuses, Valaoras determined the average "annual turnover" to be 4.4 per cent for white and 7.1 per cent for colored families.

In Crosby's paper all of the cases of syphilis discovered in 1932 resident in the Eastern Health District were traced to the nearest survey, that of 1933. A family was considered identified in the 1933 survey files if it was believed to be the family of which the syphilis case was a member when discovered, whether or not the case was reported as living with the family at the time of the 1933 census. Using the group of 260 cases (33 white, 227 colored) discovered at The Johns Hopkins Hospital, for whom a considerable amount of identifying information was available, Crosby was unable to identify in the 1933 census files either the cases or the families for 33.3 per cent of the whites and 24.9 per cent of the colored. The estimate was made, then, that 33.3 per cent of the white and 24.9 per cent of the colored households associated with syphilis cases had moved out of the Eastern Health District on an average of twelve months after discovery.

Phair used the 1933 and 1936 Eastern Health District censuses, both of which surveyed Wards 6 and 7. He divided the enumerated families into three groups, those whom he called "stable" because they were present in both the 1933 and the 1936 censuses, an "emigrant" group which was present in the 1933 census only and "immigrant" families who were present in the 1936 census only. There were no set rules used to reach a decision as to whether or not two families in different censuses were the same, but in doubtful cases the decision rested on the consensus of opinion of individuals familiar with the problem.

Using the information in these censuses, then, Phair estimated the average annual emigratory rates to be 8.8 per cent for white and 14.3 per cent for colored families, and the corresponding average annual immigratory rates to be 9.1 per cent and 15.4 per cent respectively. Table 2 shows the derivation of these rates. The interval between the censuses was taken as 2.5 years.

Phair also obtained comparable figures for families associated with tuberculosis. Using primary (first case registered in the family) cases registered in the Eastern Health District during the years 1933 through 1936 and living in the Eastern Health District at the time of registration, he sought to identify the tuberculous families in the

TABLE 2

Emigratory and immigratory rates for families of the Eastern Health District, 1933-1936

	FAMILIES IN 1933 CENSUS	PER CENT PRESENT 1933 ONLY	AVERAGE ANNUAL EMIGRATORY RATE *(Per cent)*	FAMILIES IN 1936 CENSUS	PER CENT PRESENT 1936 ONLY	AVERAGE ANNUAL IMMIGRATORY RATE *(Per cent)*
White	10,887	22.0	8.8	10,979	22.7	9.1
Colored	2,874	35.8	14.3	2,998	38.5	15.4

two census files. He considered as identified any family in the census files which included among its members one or more of the individuals listed on the family roster of the case history. Of 659 primary cases, 552 were paired by this method with 1,013 schedules in the two census files. Classifying these 1,013 schedules as he had the complete censuses, Phair obtained average annual emigratory rates of 8.2 per cent and 10.0 per cent for white and colored families, respectively, and corresponding immigratory rates of 9.5 per cent and 14.1 per cent. Table 3 shows the derivation of these rates.

TABLE 3

Emigratory and immigratory rates for tuberculous families of the Eastern Health District, 1933-1936

	FAMILIES IN 1933 CENSUS	PER CENT PRESENT 1933 ONLY	AVERAGE ANNUAL EMIGRATORY RATE *(Per cent)*	FAMILIES IN 1936 CENSUS	PER CENT PRESENT 1936 ONLY	AVERAGE ANNUAL IMMIGRATORY RATE *(Per cent)*
White	279	20.4	8.2	291	23.7	9.5
Colored	205	24.9	10.0	238	35.3	14.1

The group of 107 tuberculous families not identified in either census contained 34 families whose dates of registration or discharge

indicated that they were not present in the inter-censal period. The remaining 73 families were known to have been present in the inter-censal period, though they were not identified at either census, and so these were designated by Phair as "transient" families. A knowledge of the size of the "transient" group among the tuberculous families made it possible for Phair to estimate the same group for the Eastern Health District as a whole to be 1,346 white and 530 colored families. Table 4 shows the method of making this estimation.

TABLE 4

Estimation of the transient group in the Eastern Health District

GROUP	TYPE	WHITE		COLORED	
		Tuberculous families	Survey families	Tuberculous families	Survey families
1	Families identified in 1933 census only	57	2,398	51	1,030
2	Families unidentified in either census present in inter-censal period	35	1,346*	38	530*
3	Families identified in 1936 census only	69	2,490	84	1,154
4	Families identified in 1933 and 1936 censuses	222	8,489	154	1,844
Total		383	14,723**	327	4,558**

* By subtraction

** Estimated as follows:

$$\frac{\text{Tuberculous groups } 1 + 3 + 4}{\text{Tuberculous total}} = \frac{\text{Survey groups } 1 + 3 + 4}{\text{Survey total}}$$

Dealing with the tuberculous families Phair went further and determined emigratory and immigratory rates per 100 family-years of experience for certain subgroups. Each family present in both censuses was considered to have contributed 2.5 family-years of experience. Families present in one census only contributed one-half of 2.5

family-years, and each transient family contributed one-quarter of 2.5 family-years. Table 5 shows the results of such an analysis of the figures in Table 4.

TABLE 5

Average annual rates of migration of tuberculous families per 100 family-years contributed in the inter-censal period

	WHITE	COLORED
Emigration of		
Families identified in 1933 census	9.1	11.4
Families immigrating into the District	32.4	29.5
All tuberculous families	12.5	15.4
Immigration of		
Families identified in 1936 census	10.8	17.1
Families emigrating from the District	37.6	43.4
All tuberculous families	14.2	19.4

Phair did not derive a similar set of figures for the Eastern Health District as a whole using his estimated transient group. Table 6 shows such a derived set of rates. It will be noted that the effect of allowing for transient families is, as would be expected, to raise the estimates of migration given in Tables 2 and 3.

TABLE 6

Average annual rates of migration for Eastern Health District per 100 family-years contributed in the inter-censal period

	WHITE	COLORED
Emigration of		
Families identified in 1933 census	9.9	17.5
Families immigrating into the District	34.0	29.9
All families	13.3	20.3
Immigration of		
Families identified in 1936 census	10.2	19.1
Families emigrating from the District	35.1	32.7
All families	13.6	22.0

In addition to these estimates by Valaoras, Crosby, and Phair, another of the same kind may be made by use of the 1939 census. For each household in the census, information has been recorded as to the address of the head of the household on January 1, 1936, i. e. on the average, about three and one-half years prior to the census. For Wards 6 and 7, with 11,882 white and 3,414 colored households enumerated in the 1939 census, it was recorded that 18.5 per cent of the white and 24.7 per cent of the colored heads of the households were not in the wards on January 1, 1936. To make these figures comparable to the rates previously listed, they should be divided by three and one-half, and called annual immigratory rates of 5.3 per cent and 7.1 per cent for whites and colored respectively.

Table 7 is a summary table of the rates thus far presented, not including, however, the rates suggested by Phair which allow for transients. For a number of reasons these rates are not comparable, due to differences implicit in their derivation and definition. Such differences are among the issues which should be considered before any two migration rates based on net non-migration are compared, and so it would seem worthwhile to mention them in some detail.

In the first place it may be remarked that inasmuch as the rates were derived from data pertaining to various intervals of a nineteen-year period, one must bear in mind the possibility of the occurrence during this time of a real change in the rate of migration. It is not a function of the present paper to examine this possibility for the Eastern Health District, but the problem of secular trend is a general one and should not be overlooked.

A second point, and one concerned with definition, is that some of the rates in Table 7 are emigratory, others immigratory. A moment's reflection on the meaning of these rates will make it apparent that although for a particular community they may be equal, there is no necessity for this.

Another factor pertaining to the comparability of the rates is the fact that the methods of identifying families were not the same. The problem of determining whether two families in different censuses are the same is theoretically a complex one. Nevertheless, it is likely, because the great bulk of the judgments agree, under differing criteria, as to whether two records pertain to the same family, that this factor is a minor one.

TABLE 7

Migration estimates (Average annual rates)

SOURCE AND DESCRIPTION OF RATE	INTERVAL BETWEEN OBSERVATIONS IN YEARS	MIGRATION RATES *(average annual per cent)*	
		White	Colored
Crosby, emigratory rate for syphilitic families of Wards 6 and 7, 1932 syphilis discoveries at Johns Hopkins Hospital and 1933 census	1.0	33.3	24.9
Phair, emigratory rate for all families of Wards 6 and 7, 1933 and 1936 censuses	2.5	8.8	14.3
Phair, immigratory rate for all families of Wards 6 and 7, 1933 and 1936 censuses	2.5	9.1	15.4
Phair, emigratory rate for tuberculous families of Wards 6 and 7, 1933 and 1936 censuses	2.5	8.2	10.0
Phair, immigratory rate for tuberculous families of Wards 6 and 7, 1933 and 1936 censuses	2.5	9.5	14.1
Present paper, immigratory rate for all families of Wards 6 and 7, 1939 census	3.5	5.3	7.1
Valaoras, immigratory rate for all families of Ward 7, 1922 and 1933 censuses	11.0	4.4	7.1

A fourth factor and one less obvious than the previous ones, although of great importance, is that for rates such as these under discussion, a difference in the size of the area to which they pertain amounts to a difference in the definition of migration with a corresponding change in the derived rates. It has been stressed that one of the fundamental elements of the definition of migration is the statement of the minimum move that is accepted as a migration, and since, here, the minimum move is any move larger than an intra-area move, Valaoras' definition differs from the others. The size of the minimum move (as determined by the area size) has two opposite influences on a net non-migration rate, and consequently on its complement, the migration rate. The larger this minimum move is, the relatively fewer will be the number of moves called migrations, and so, the larger will be the true non-migration rate. But the greater the minimum move,

that is, the greater the area whose boundaries define a migration, the relatively greater will be the number of subjects classified as non-migrating who actually had two such moves which were compensatory between the two periods of observation. This would tend to decrease the net non-migration rate. The end result of these two opposing influences will depend on the characteristics of the particular areas under observation.

The next point also is concerned with the fundamental definition of migration, but this time with the selection of the subject of the migration. Crosby's rate pertained to families associated with syphilis, two of Phair's pertained to tuberculous families, the other rates in the table were for all families in the areas under observation. Crosby's syphilitic and Phair's tuberculous families are thus samples from the universe to which the other rates apply, but are selected in such a way that there is obviously a likelihood of bias. As a matter of fact, one of Crosby's conclusions was that syphilitic families are more migratory than the average, and Phair concluded that tuberculous families *in the Eastern Health District of Baltimore* are less so. In these instances, of course, the samples were deliberately selective in order to examine what bias in stability of residence was present in families associated with syphilis and tuberculosis. Such is not always the case and so in comparing any two migration rates, care should be taken to examine the subject selected for possible unintentional bias.

A final reason for the lack of comparability of the rates is the fact that annual rates derived as these were by dividing the x-year migration rate by x will vary according to the size of x. This is due to the fact that when a given population of families is followed in time, the decrease in the number of non-migrants is not uniform. Definite evidence on this point will be shown later in the paper, but it may be noted here that the figures summarized in Table 7 are in line with this, for the shorter the interval of observation, the higher the annual rate.

Attention has been called to the fact that the rates here are not total emigratory or immigratory rates but net rates. Phair recognized this and was able to estimate a correction for it. His method of doing this has been described. However, one might expect his tuberculous transient group to be underestimated, for one would suppose that a smaller proportion of a very mobile group of tuberculosis cases would be picked up and registered, than of a more stable group. But even assuming the tuberculous transient group to be correct, using it as an

estimate for the general population would yield an underestimation, if Phair's conclusion that tuberculous families in the Eastern Health District are more stable than the general population is correct.

We shall turn now to the analysis of migration rates for the Eastern Health District based on a different type of observation. The studies just presented were based on a knowledge of the identity of the subjects of the study, but with fairly long intervals between observations on them. In the following study, not only was a knowledge of the identity of the subject maintained, but the population was kept under virtually continuous observation. Before presenting the migration material itself, a word should be said as to the source of the material and the method of its collection.

In a study of illness among white families in the Eastern Health District of Baltimore, conducted by the United States Public Health Service and the Milbank Memorial Fund, monthly visits were made to the houses in certain selected blocks to determine the history of morbidity of the residents of these houses during the previous month. Information regarding the movement of families in the study blocks was also obtained. It is this latter information which is to be examined presently.

The pertinence of such information to the problems of health and particularly to public health administration may be indicated by pointing out that most public health work is so organized that the individual worker is concerned with a population within a limited geographical area. Migration, being a factor which alters the population of a given area is, thus, of vital importance to any sustained public health program. For example, such problems as measuring the effectiveness of a preventive treatment, or studying a chronic disease, require the observation of individuals for extended periods of time. These necessary follow-up studies are made difficult largely because some of the individuals under observation move, and the more frequent the moves or the greater the distance moved, the more difficult the problem becomes. It was a problem such as this that led Crosby and Phair, whose work has already been mentioned, to investigate certain aspects of migration within the Eastern Health District. Other factors also, such as the relation of migration to housing and of housing to health, the usually excessive requirements of migrants for medical care, and the possibility that migrants will provide the means for an infection to

spread from one community to another, make a knowledge of the local migration situation valuable to public health administration.

When the illness study was initiated, the Eastern Health District consisted of Wards 6 and 7, which included about 11,900 white families or 43,400 white individuals, and about 3,400 colored families or 13,800 Negroes. Since then, the Eastern Health District has been enlarged and now includes an area with a total population of about 100,000, but the sample for the present study was chosen from the earlier area and it is this smaller area which will be referred to in the following discussion as the Eastern Health District. Details of the method of sampling are given by Downes and Collins in a preliminary report published in 1940[5]. As they explain, "entire city blocks in each of the ten census tracts (of Wards 6 and 7) were selected by picking square blocks roughly according to a checkerboard pattern. An effort was made to select a sufficient number of blocks from each census tract so that the sample drawn from each tract would constitute the same percentage of the total sample population as the white population of that census tract was of the total white population of the entire Eastern Health District." Thirty-five blocks were finally selected and comparison of the white population of these blocks with that of the District indicates that the sample population is representative with respect to age constitution, size of family, and home ownership.

Table 8 presents a comparison of the thirty-five study blocks with all the blocks in the District with regard to migration as indicated by the 1939 census data, and this furnishes a further very pertinent estimate of their representativeness for the present study. As indicated earlier, the 1939 records contain information as to the residence of the heads of households on January 1, 1936. Making four classifications of these 1936 residences as follows: same address as in 1939, other address in the District, elsewhere in Baltimore, and outside Baltimore, and comparing the results for the study blocks and the other blocks, there is found to be sufficient agreement to confirm the opinion that the sample is not unduly biased.

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[5] Downes, Jean, and Selwyn D. Collins. A study of illness among families in the Eastern Health District of Baltimore. *Milbank Memorial Fund Quart.*, 18: 5-26, 1940.

TABLE 8

Distribution of study blocks and all blocks in the Eastern Health District as to the January 1, 1936 addresses of the 1939 white heads of households

BLOCKS	NUMBER AT GIVEN ADDRESS JANUARY 1, 1936					PER CENT AT GIVEN ADDRESS JANUARY 1, 1936				
	Same as 1939	Other in District	Elsewhere in Baltimore	Outside Baltimore	Total	Same as 1939	Other in District	Elsewhere in Baltimore	Outside Baltimore	Total
Study	1,054	338	218	98	1,708	61.7	19.8	12.8	5.7	100.0
Total	7,542	2,136	1,590	614	11,882	63.5	18.0	13.4	5.1	100.0

The time covered by the illness study is from May 23, 1938 to June 22, 1941, and is divided into thirty-seven visit periods which extend from the twenty-third of one month to the twenty-second of the next. The order in which the blocks were visited was approximately the same each month and so the visits may be taken as monthly cross-sections. Although the observation is, thus, really not continuous but made up of a series of discrete observations, it is felt that the results are nearly, though not exactly, equivalent to those which would have been obtained by continuous observation, i. e. that an insignificant number of moves was missed because they were made by households moving into and out of the study between visits.

All changes of residence of white households, even including moves within a house, were included on the morbidity study records, but *only moves resulting in a change of address are considered here.* For each move, inquiry was made as to origin or destination. If information regarding destination was not provided or was incompletely furnished by the morbidity study records, supplementary information on this point was sought at other sources. These will be discussed later.

The unit of the study is the family or household. These terms are considered synonymous, since both were taken to mean a group of individuals living together as a single family.

TABLE 9A

Moves of households by visit for blocks other than 118

DATE	VISIT	HOUSEHOLDS PRESENT	HOUSEHOLDS ENTERING STUDY BY NEXT VISIT	HOUSEHOLDS LEAVING STUDY BY NEXT VISIT
5/23/38 to 6/22/38	1	1,589	29	45
	2	1,573	36	23
	3	1,586	18	31
	4	1,573	35	35
	5	1,573	33	30
	6	1,576	23	19
11/23/38 to 12/22/38	7	1,580	18	17
	8	1,581	27	22
	9	1,586	13	18
	10	1,581	26	25
	11	1,582	40	34
	12	1,588	25	28
5/23/39 to 6/22/39	13	1,585	28	30
	14	1,583	27	31
	15	1,579	24	21
	16	1,582	25	32
	17	1,575	40	30
	18	1,585	27	23
11/23/39 to 12/22/39	19	1,589	16	19
	20	1,586	23	17
	21	1,592	23	21
	22	1,594	22	28
	23	1,588	34	28
	24	1,594	35	39
5/23/40 to 6/22/40	25	1,590	31	30
	26	1,591	20	20
	27	1,591	35	24
	28	1,602	25	28
	29	1,599	24	25
	30	1,598	22	25
11/23/40 to 12/22/40	31	1,595	15	11
	32	1,599	17	21
	33	1,595	19	16
	34	1,598	17	21
	35	1,594	24	30
	36	1,588	22	34
5/23/41 to 6/22/41	37	1,576	...	...
Total			918	931

TABLE 9B

Moves of households by visit for Block 118

DATE	VISIT	HOUSEHOLDS PRESENT	HOUSEHOLDS ENTERING STUDY BY NEXT VISIT	HOUSEHOLDS LEAVING STUDY BY NEXT VISIT
5/23/38 to 6/22/38	1	109	13	15
	2	107	13	12
	3	108	16	16
	4	108	12	17
	5	103	18	9
	6	112	18	18
11/23/38 to 12/22/38	7	112	10	16
	8	106	12	10
	9	108	11	10
	10	109	14	9
	11	114	17	15
	12	116	11	15
5/23/39 to 6/22/39	13	112	9	13
	14	108	14	12
	15	110	18	11
	16	117	9	11
	17	115	17	14
	18	118	18	19
11/23/39 to 12/22/39	19	117	12	18
	20	111	16	8
	21	119	15	15
	22	119	8	7
	23	120	13	12
	24	121	17	20
5/23/40 to 6/22/40	25	118	18	18
	26	118	18	15
	27	121	...	...
Total			367	355

From Tables 9A and 9B the following monthly rates may be derived:

				Blocks other than 118 (Per cent)	*Block 118 (Per cent)*	*Total (Per cent)*
Entry rate	$= \frac{\text{No. of households entering the study}}{\text{Household-months of experience}}$	$\times$	100	1.6	12.5	2.1
Removal rate	$= \frac{\text{No. of households leaving the study}}{\text{Household-months of experience}}$	$\times$	100	1.6	12.1	2.1

If a move is defined, as here, as a change of address, two further definitions seem to follow sensibly. First, a household will be said to leave the study upon moving from a given address in the study blocks, and it will be said to enter the study when it takes a new address in the study.[6] Second, a single identifiable household unit may be treated as one or more households according to the number of times it enters the study blocks. In fact, there are 2,838 different families in the study, of which 2,705 are counted once, 123 twice, 8 three times and 2 four times, making under the definitions just stated, a total of 2,983 families.

Among the thirty-five blocks, Block 118, composed chiefly of cheap apartments, tenements, and rooming-houses, was soon recognized to have a much greater migration rate than that of the other blocks. As a result, it presented such difficulty for the morbidity study that it was dropped following the twenty-seventh visit. Information regarding this block is presented separately in the present study.

Turning to the results of the study, Tables 9A and 9B show by visit for blocks other than 118, and for Block 118 separately, all moves occurring in the study, together with the number of families present. The number of families present remains fairly constant. However, there is systematic fluctuation in the number of moves, which is clearly shown for blocks other than 118 (see Fig. 1), but is less apparent in the case of Block 118. The periods of maximum migration appear to be in the neighborhood of September and October in the fall and of April and May in the spring; and there is less migration in winter than in summer. This distribution is in accord with general observation.

From these rates the great difference between Block 118 and the other blocks is apparent.

The entry rate for households, as given, is simply a weighted average of the rates formed thus:

$$\frac{\text{No. entering between visits } x \text{ and } x+1}{\text{Av. no. present between visits } x \text{ and } x+1} \times 100,$$

[6] However, when a new household is created by breaking off from a larger household, or when an existing household is lost by absorption into another household, the household is said to enter or leave the study, respectively, whether or not a change of address has occurred. Such instances were rare.

the weight of each rate being its denominator. An entry rate of 2.1 per cent means that in a community of 1,000 households there will be in the course of an average month 21 households who will take new addresses in the community. The rate may also be said to mean that on the average 2.1 per cent of the households in a community have resided at their present addresses less than one month. This last statement is possible since, in line with an earlier assumption, the number of households moving more often than once a month is believed negligible.

Similarly, the removal rate is a weighted average of the rates formed thus:

$$\frac{\text{No. leaving between visits } x \text{ and } x+1}{\text{Av. no. present between visits } x \text{ and } x+1} \times 100,$$

the weight of each rate again being its denominator. The removal rate of 2.1 per cent means that in a community of 1,000 households there will be in the course of an average month 21 households who will move from their addresses in the community.

These rates are average monthly incidence rates based on three years' experience for blocks other than 118 and on two years and two months' experience for Block 118. Fig. 1, already referred to, which shows the seasonal variation of migration, emphasizes the fact that, being averages, the rates are not applicable to any specific month.

They are capable, however, of being transformed into rates using other time units. For time units shorter than a month, their meaning is not altered except as to the time involved. But for longer intervals the distinction between the number of moves and the number of separate households must be taken into account. Thus, if the entry rate of 2.1 percent per household-month of experience is transformed to the rate 25.2 percent per household-year of experience, its new meaning is that in a community of 1,000 households there will be in the course of an average year 252 new addresses taken, but it is recognized that the number of separate households involved in this moving may be less than 252 because of repeated moves by some households.

When put on an annual basis, the rates must still be recognized as averages and not taken to represent any particular year. This is so because there is some evidence of a secular decline in both entry and removal rates. Table 10 summarizes this evidence. The series

is too limited to establish the significance of the trend, but that such a trend may occur could scarcely be doubted.

TABLE 10

Entry and removal rates by year for blocks other than 118 and for Block 118

BLOCKS	FOR MONTHS FOLLOWING VISITS	RATES *(Per cent)*	
		Entry	Removal
Othen than 118	1-12	1.703	1.724
	13-24	1.702	1.676
	25-36	1.416	1.490
118	1-12	12.562	12.333
	13-24	11.942	11.511

It should be clear from the definitions of the rates that if the removal rate exceeds the entry rate, the number of households in the community decreases, and if the removal rate is less than the entry rate, the number of households increases.

A fruitful method of examining the permanency of residence of households is to compare the non-migration curve of the households present at the start of the study with that of the households entering the study at some time other than the start. In the subsequent discussion, the former group of households will be called original households, the latter incoming households. It is to be noted that by the definitions of entry and removal it is possible for a particular incoming household to have occupied another address in the study blocks at the beginning of the study.

The non-migration curves are presented in Fig. 2A and 2B for the original and incoming households of blocks other than 118 and of Block 118. The basic figures for Block 118 were small, but the curves are offered as suggestive of the situation for a highly migratory population. The non-migration curves indicate that the probability of moving within a specified time (this probability is reflected by the slope of the curves) decreases as the length of maintaining the same residence

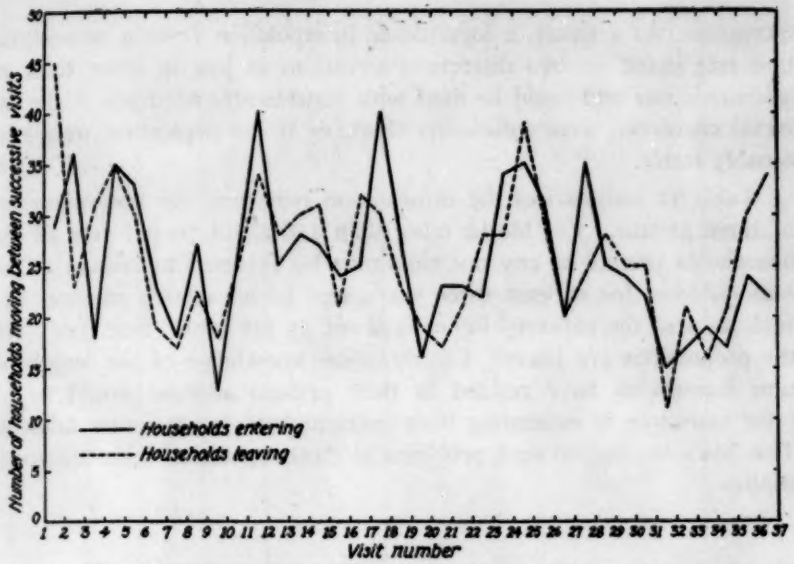

FIG. 1. MOVES OF HOUSEHOLDS BY VISIT FOR BLOCKS OTHER THAN BLOCK 118

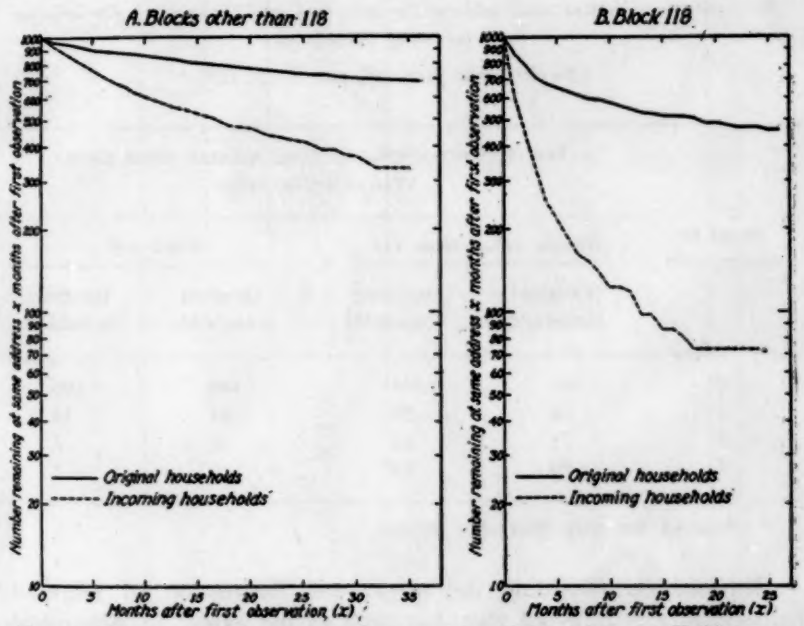
A. Blocks other than 118
B. Block 118
Number remaining at same address x months after first observation
Original households
Incoming households
Months after first observation (x)

FIG. 2. NUMBER OF HOUSEHOLDS REMAINING AT SAME ADDRESS X MONTHS AFTER FIRST OBSERVATION

increases. As a result, a logarithmic interpolation from a non-migration rate based on two discrete observations is less in error than an arithmetic one and could be used with considerable accuracy if the interval concerned were sufficiently short, or if the population were reasonably stable.

Table 11 summarizes the information regarding the non-migration of these groups. For blocks other than 118 about 70 per cent of the households present at any one time may be expected to remain at the same address for at least three years, and of households moving into such an area the expected figure is about 35 per cent. For Block 118 the proportions are lower. Clearly, some knowledge of the length of time households have resided at their present address would be of great assistance in estimating their continued stay at the same address. This has a bearing on such problems as those associated with follow-up studies.

TABLE 11

Per cent remaining at same address for one, two, and three years for original and incoming households

(Blocks other than 118, and Block 118)

YEARS OF OBSERVATION	PER CENT REMAINING AT SAME ADDRESS AFTER EACH YEAR OF OBSERVATION			
	Blocks other than 118		*Block 118*	
	Original households	Incoming households	Original households	Incoming households
0	100	100	100	100
1	84	58	54	12
2	75	43	47	7
3	69	34*	...	...

* Observed for only thirty-five months

Information regarding the origin and destination of migratory households was collected also, but only to the extent of determining whether the origin or destination was in the Eastern Health District,

TABLE 12

Origins and destinations of households migrating, blocks other than 118, and Block 118*

	ORIGIN OR DESTINATION								
	Number				*Per cent of total known*				
	E.H.D.	Elsewhere in Baltimore	Outside Baltimore	Unknown	Total	E.H.D.	Elsewhere in Baltimore	Outside Baltimore	Total
Blocks other than 118									
Households entering study	449	340	68	61	918	52.4	39.7	7.9	100.0
Households leaving study	359	292	84	178	913	48.9	39.7	11.4	100.0
Block 118									
Households entering study	127	142	78	20	367	36.6	40.9	22.5	100.0
Households leaving study	82	66	55	151	354	40.4	32.5	27.1	100.0

* Nineteen households who moved because of the death of the head are not included in this tabulation.

in some other part of Baltimore, or outside Baltimore. As would be expected, a larger proportion of destinations than of origins was left undetermined. Table 12 summarizes the information regarding origin and destination for blocks other than 118 and for Block 118. That short moves are more frequent than long ones is indicated by the fact that for blocks other than 118 nearly 50 per cent of the moves are known to be within the Eastern Health District. This may be considered a minimum estimate, since the unknown destinations, although probably biased in the direction of containing an undue proportion of long moves, doubtless contains some moves within the Eastern Health District.

Because of the large number of removals with unknown destination, a word should be added about the endeavors made to reduce this figure. The chief source of information regarding place of removal was from the morbidity study records, that is, the information was obtained from the households themselves prior to removal, from their neighbors subsequent to removal or, occasionally, merely by virtue of the fact that the removal was to another address within the study blocks. Of these, the reliability of the information from neighbors is especially open to question.

The telephone directory or city directory, when these applied to dates after, but not too long after, the date of removal, were of use to supplement approximate information about place of removal or even as the sole source of this information. In the latter case, there should be further investigation to determine if the address provided was truly the first address taken by the household following the removal under question.

Another supplementary source of information of use for about the first year of the study was the 1939 Eastern Health District census. It was of value only if the household being examined was in the Eastern Health District at the time of the census; but this source was not open to the objections found to the use of the directories, since the census provided data regarding all recent moves. The 1939 census with its family rosters had the additional advantage of providing positive identification of the households. Such a source as this would not usually be available to an investigator.

Chief reliance for supplementary information was placed on the post office, since it could be used throughout the entire study period.

The procedure adopted was to provide the post office at regular intervals with the names and addresses of the heads of the households whose place of removal was unknown. For a nominal charge the post office corrected these "mailing lists." To examine the usefulness of this procedure all removals, whether the destinations were or were not provided by the morbidity study, were referred to the post office from the twelfth through the eighteenth visit. Table 13 presents the results of this investigation. It can be seen that the unknowns were reduced by more than 50 per cent. A suggestion as to the accuracy of the addresses provided by the post office is found in the fact that of the 110 addresses from the post office for which addresses were also obtained by the morbidity study 83, or 75 per cent, were corroboratory.

TABLE 13

Place of removal according to morbidity study and Post Office, for removals from the twelfth through eighteenth visit*

POST OFFICE ADDRESS	MORBIDITY STUDY ADDRESS			
Definite	Definite	Approximate	Unknown	Total
Corroboratory	51	32		
Not corroboratory	17	10		
Total	68	42	32	142
Unknown	30	15	21	66
No move recorded	11	2	3	16
Total	109	59	56	224

* Moves from one address to another within the study blocks were not included here.

Since the most satisfactory means of supplementing information regarding place of removal still leaves an unkown group of about 10 per cent, the conclusion is suggested that complete registration of changes of address, either under compulsion or as a result of unusual cooperation on the part of the observed population, is necessary for an adequate determination of the destination of removals.

SUMMARY

This paper discusses some of the inherent problems involved in the analysis of the extent of migration of a population, and presents evidence on the movement of the population of the Eastern Health District, Baltimore.

In any such study it is essential that both the unit whose migration is being described and the exact nature of the move that is classified as a migration, should be defined.

The selection of rates to describe the extent of migration depends on the methods of obtaining the observations. There are two methods open for selecting a universe for study, that of following the migration of a particular group of identified subjects, or that of observing the migration pertaining to a given area. In the former case, not only individual identification of the subjects, but also essentially continuous observation on them is required. For an area study, these two requirements are not essential, although without them the description of migration is less complete.

Various studies pertaining to migration characteristics of the Eastern Health District of Baltimore have been carried out. In some cases these studies have been incidental to the following of certain disease groups. The results of these are summarized here and, in addition, the paper presents some new material based on virtually continuous observation of the same group of houses into and from which people are migrating. As with the other studies, the household was the unit of observation.

A migration was defined as any inter-house move. From the evidence of this study, the estimate was made that in the Eastern Health District there are about 2.1 moves per 100 white households per month. The probability of a household's moving within a specified time was found to decrease with an increase in the length of time it had continuously occupied its present residence. Although it was determined that short moves, either within the District or in the City constituted the majority of all moves, considerable difficulty was found in determining the destination of all households leaving the study area. It was felt that compulsory registration or unusual cooperation on the part of the observed population would be necessary to secure adequate information on this point.

FEMALE-MALE INDEX OF BODY BUILD IN NEGROES AND WHITES: AN INTERPRETATION OF ANATOMICAL SEX DIFFERENCES

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PERHAPS the most classical comparison of the sexes in statistics is the well-known sex ratio which shows that for most human populations, around 106 males are born to every 100 females (1.2). Ratios, showing differences between male and female body dimensions, are less well known, although everyone is aware that human males are larger for the most part than females. This sex difference may be determined by dividing the dimensions of the female by those of the male. This has been done frequently for stature but more rarely for the other body dimensions. In this study more than 50 dimensions and body indices are discussed, using this sex ratio as an index.

All the data considered in this problem were collected by Steggerda.

The Negro data were gathered at Tuskegee Institute, Alabama.[1] The subjects taken at random from the physical education classes in the college department are approximately of the same age and economic level. They are not full-blood Negroes, but represent a hybrid population of Negro, Indian, and White with perhaps a predominance of Negro blood. They are, however, classified as typical American Negroes. The Dutch-White material used for comparison has been previously published.[2] They were middle-aged parents, living in Holland, Michigan. Occasionally in this paper we cite data on Blacks,

[1] The authors wish to express appreciation to members of the Physical Education Department for help in collecting and recording the data and especially to Clive L. Abbott, Director of Physical Education at Tuskegee Institute, for permission and cooperation in carrying on this project in their department.

[2] Steggerda, 1932 (3).

Browns, and Whites living in the island of Jamaica, B.W.I.[3] The technique of measuring has been described by Steggerda in previous publications (5, 6, 7).

The mean values and their probable errors for the most important body dimensions as obtained by the measurements of 100 Tuskegee men and 100 Tuskegee women are given in Table 1. They comprise 16 items on the trunk, 27 on the appendages, 21 on the head, and four more items not readily classified. The absolute dimensions are

TABLE 1

Means with probable errors of bodily dimensions for 100 male and 100 female Tuskegee Negroes, and the sex differences between them with probable errors

All absolute measurements given in mm. (unless differently stated), all relative measurements, or body indices, in per cent.

MEASUREMENTS	MALE	FEMALE	DIFFERENCE
Measurements of the trunk			
Weight in kgs.	70.06± .61	55.84± .47	14.22± .77
Stature	1749.3 ±4.71	1633.1 ±4.55	116.2 ±6.55
Sitting height	890.3 ±2.13	837.4 ±2.11	52.9 ±3.00
Sitting height / Stature	50.92± .09	51.31± .09	.39± .13
Chest girth	904.0 ±3.55	803.9 ±2.80	100.1 ±4.52
Chest girth / Stature	51.64± .19	49.12± .18	2.52± .26
Chest transverse	288.6 ±1.22	251.4 ± .98	37.3 ±1.56
Chest depth (ant.-post.)	213.5 ± .97	191.0 ± .97	22.5 ±1.37
Chest transverse / Sitting suprasternale	50.16± .22	46.46± .20	3.7 ± .30
Biacromial breadth	410.5 ±1.28	370.1 ±1.05	40.4 ±1.66
Intercristal breadth	289.2 ±1.23	276.2 ±1.16	13.0 ±1.69
Intercristal breadth / Biacromial breadth	70.64± .25	74.76± .27	4.12± .37
Interspinale breadth	251.1 ± .94	239.9 ±1.14	11.2 ±1.48
Acromion height	1426.1 ±4.69	1331.9 ±4.44	94.2 ±6.46
Iliospinale height	1009.9 ±3.49	944.3 ±3.59	65.6 ±5.01
Height of head and neck	311.9 ± .74	292.4 ± .84	19.5 ±1.12

[3] Davenport annd Steggerda, 1929 (4).

TABLE 1 (*Continued*)

MEASUREMENTS	MALE	FEMALE	DIFFERENCE
Measurements of the appendages			
Span	1847.5 ±5.43	1709.1 ±5.78	138.4 ±7.93
Span / Stature	106.24± .15	104.58± .19	1.66± .24
Radiale height	1094.9 ±3.76	1025.3 ±3.40	69.6 ±5.07
Stylion height	832.5 ±3.09	780.3 ±2.88	52.2 ±4.22
Dactylion height	622.7 ±2.65	587.5 ±2.67	35.2 ±3.76
Total arm length (Acromion-dactylion)	804.1 ±2.66	744.2 ±2.74	59.9 ±3.82
Net arm length (Acromion-stylion)	593.7 ±2.03	551.4 ±2.25	42.3 ±3.03
Acromion-stylion / Stature	33.89± .06	33.80± .08	.09± .10
Upper arm length	331.2 ±1.22	306.3 ±1.37	24.9 ±1.83
Upper arm / Total arm	41.18± .07	41.24± .07	.06± .10
Lower arm length	262.5 ±1.04	244.7 ±1.12	17.8 ±1.53
Lower arm / Total arm	32.68± .07	32.86± .08	.18± .11
Upper arm / Net arm	55.76± .08	55.64± .10	.12± .13
Lower arm / Net arm	44.25± .08	44.37± .10	.12± .13
Lower arm / Upper arm (brachial index)	79.40± .27	79.85± .30	.45± .40
Upper arm girth	292.2 ±1.60	243.6 ±1.62	48.6 ±2.28
Lower arm girth	279.1 ±1.18	236.9 ±1.04	42.2 ±1.66
Hand length	207.8 ± .74	192.1 ± .65	15.7 ± .98
Hand breadth	91.4 ± .34	80.1 ± .32	11.3 ± .47
Hand breadth / Hand length (hand index)	43.90± .16	41.78± .15	2.12± .22
Leg length I (vertex height-sitting height)	859.1 ±3.25	793.5 ±3.12	65.6 ±4.51
Leg length II (iliospinale height-45 or 35 mm.)	964.9 ±3.13	910.1 ±3.18	54.8 ±4.46
Tibiale height	499.7 ±2.02	461.1 ±1.75	38.6 ±2.67
Calf girth	362.3 ±1.59	339.7 ±1.61	22.6 ±2.26
Foot length	274.2 ± .95	249.5 ± .80	24.7 ±1.24
Foot breadth	94.3 ± .44	85.7 ± .38	8.6 ± .58
Foot breadth / Foot length (foot index)	34.41± .14	33.50± .13	.91± .19

TABLE 1 (*Continued*)

MEASUREMENTS	MALE	FEMALE	DIFFERENCE
	Measurements on the head		
Head length	199.7 ± .44	189.3 ± .46	10.4 ± .64
Head width	152.8 ± .37	144.5 ± .30	8.3 ± .48
$\frac{\text{Head width}}{\text{Head length}}$ (cephalic index)	76.56± .21	76.39± .20	.17± .29
Head girth	576.9 ±1.22	564.0 ±1.23	12.9 ±1.73
Minimum frontal breadth	113.8 ± .35	110.8 ± .30	3.0 ± .46
$\frac{\text{Minimum frontal breadth}}{\text{Head width}}$	74.51± .21	76.70± .18	2.19± .28
Bizygomatic breadth	140.2 ± .39	132.6 ± .31	7.6 ± .50
Bigonial breadth	109.9 ± .34	104.6 ± .29	5.3 ± .45
Trichion to gnathion	191.7 ± .69	177.7 ± .61	14.0 ± .92
Nasion to gnathion	132.9 ± .48	125.6 ± .40	7.3 ± .62
$\frac{\text{Nasion to gnathion}}{\text{Bizygomatic breadth}}$	94.88± .38	94.72± .29	.16± .48
Nasion to subnasion (nasal length)	61.2 ± .28	59.3 ± .27	1.9 ± .39
Nasal breadth	43.9 ± .20	41.0 ± .18	2.9 ± .27
$\frac{\text{Nasal breadth}}{\text{Nasal length}}$ (nasal index)	72.12± .42	69.54± .37	2.58± .56
Nasion to stomion	86.2 ± .33	82.8 ± .33	3.4 ± .47
Mouth width	54.7 ± .27	50.7 ± .22	4.0 ± .35
Ear length	61.1 ± .24	58.9 ± .26	2.2 ± .35
Ear breadth	37.8 ± .18	36.2 ± .15	1.6 ± .23
$\frac{\text{Ear breadth}}{\text{Ear length}}$ (ear index)	61.88± .30	61.64± .28	.24± .41
$\frac{\text{Interpupillary distance}}{\text{Head width}}$	45.74± .16	46.78± .14	1.04± .21
	Various measurements		
Age in years	21.15± .15	20.05± .13	1.10± .20
Eye color in Martin numbers*	14.44± .13	14.50± .11	.06± .17
Right hand grip in kgs	50.20± .54	27.30± .47	22.90± .72
Left hand grip in kgs	46.92± .61	25.54± .46	21.38± .76

* Augenfarben-Tafel, nach Rud. Martin und Bruno K. Schultz, J. F. Lehmanns Verlag, München.

given in millimeters, the most usual body indices in per cent, and some few measurements in other units as indicated in the headings of the table. All male and female measurements and their differences, showing the sexual dimorphism of each item, are presented in Table 1, where they are arranged in a logical order of measurements taken on trunk, appendages, and head, respectively.

TABLE 2

Physical measurements of 100 male and 100 female Tuskegee Negroes: Trunk and various other measurements

Arrangement of the female-male ratios in order of magnitude.

	F/M INDEX	DIFFERENCE / P.E. OF DIFFERENCE
Measurements of trunk		
Weight in kgs.	.797	18.5
Chest transverse	.871	23.9
Chest girth	.889	22.2
Chest depth	.895	16.4
Biacromial breadth	.902	24.3
Chest transverse / Sitting suprasternale	.926	12.3
Stature	.934	17.7
Acromion height	.934	14.6
Iliospinale height	.935	13.1
Height of head and neck	.937	17.4
Sitting height	.941	17.6
Chest girth / Stature	.951	9.7
Intercristal breadth	.955	7.7
Interspinal breadth	.955	7.6
Sitting height / Stature	1.008	3.0
Intercristal breadth / Biacromial breadth	1.058	11.1
Various measurements		
Right hand grip in kgs.	.544	31.8
Left hand grip in kgs.	.544	28.1
Age in years	.948	5.5
Eye color in Martin numbers	1.004	.4

In order to get a clearer insight into the meaning of the sexual dimorphism, Tables 2, 3 and 4 contain the female/male indices as computed from the mean values. These indices are separately arranged for trunk, appendages, and head by order of their magnitude in each division. The statistical significance of the sex difference is also added to these tables. For comparison, the corresponding values for the Dutch-White men and women are given in the text, as well as such values as are available for the Jamaicans.

TRUNK

Weight: F/M index = .797.

The sex ratio for weight is the lowest of all indices obtained. This low weight ratio clearly demonstrates the well-known fact that, on the average, adult females weigh less than males. In the present sample of the Negro race the men weigh 70.06 kilograms; the women 55.84 kilograms. The difference is more than 20 per cent, the female/male index being .797. This sex difference is even greater than that found by Davenport and Steggerda (4) for the Jamaica Blacks (.814), which in turn showed a much higher sexual dimorphism than the Browns (.875) or the Whites (.834). The sex difference in weight, of course, is due to the greater stature of the adult males.

In the growing ages up to 10 years, when the sexes are of about the same stature, there is also no considerable sex difference in weight to be observed (Wolff, 8a, 8b). It is further known that in the years of prepuberty (11 to 14 years of age), when the girls surpass the boys somewhat in body height, they also exhibit a greater body weight. For these years, therefore, the female/male index of height and weight becomes greater than one (9).

Chest transverse: F/M index = .871; *Chest girth:* F/M index = .889; *Chest depth:* F/M index = .895.

The three female-male indices of the chest measurements are about the same. They all are relatively low and clearly demonstrate the larger dimensions of the male chest in every direction. It is further remarkable that these indices of our Tuskegee group are distinctly lower than those of a group of white Dutch men and women from Holland, Michigan. The corresponding values of the F/M index for the Dutch Whites were in order of magnitude: Chest depth (anterior-

posterior) .937, Chest girth .957, Chest transverse .963. Thus the difference in chest measurement in the male and female figures is more outstanding in the Negro group under investigation than it is in the Dutch Whites.

Relative chest girth = index of body build: F/M index = .951.

The F/M index for relative chest girth, i.e. chest girth divided by stature, is much higher in both sexes than the sex ratio for the absolute values of those dimensions. In other words, the ratios of these body proportions for both sexes are more nearly equal, the value being .951. This F/M index in the group of Dutch men and women is still higher, with 1.023 which exceeds unity. The relative chest girth in this group was 53.40 per cent for males, 54.63 per cent for females, whereas, for the Tuskegee (see Table 1) the values are 51.64 and 49.12 per cent respectively. Yet it should be mentioned that both groups are of a different age average. The Tuskegee males are somewhat over 21, the females, 20 years of age, as compared to an average age of 35 for the Dutch males, and of 36 years for the females. It is possible that the larger development of the chest dimensions in the Dutch women is partly due to the age factor connected with the fact that the latter females probably have had several childbirths.

Biacromial breadth: F/M = .902.

The next highest index for the trunk is the F/M ratio of biacromial breadth. In the Tuskegee the young females are about 90 per cent as broad in this respect as the young males. The index in the Dutch group was .926; in the Jamaica "Blacks", "Browns", and "Whites", .925, .924, and .904. These indices do not show a wide range. The departure from unity, however, is greater in the Whites and corresponds almost exactly to the findings in the present study of Tuskegee Negroes. As an explanation, Davenport and Steggerda wrote (*l.c.* p. 57): "The low shoulder breadth of the Whites is probably due to the fact that they were partly girls who did little manual labor." This may hold true also for the Tuskegee girls.

$$\frac{\textit{Chest transverse}}{\textit{Sitting height suprasternale}} = \text{trunk index: F/M} = .926.$$

The F/M index for chest transverse divided by sitting height suprasternale is considered to be an index of trunk robusticity, breadth,

or stockiness. The sex ratio for this measurement is low among the Tuskegee students, indicating that the females were less stocky than the males. The low F/M index is still more evident when compared to the races in Jamaica whose corresponding F/M indices were .995 for Blacks, .979 for Browns, .987 for Whites, which means that there is practically no difference in torso configuration between the sexes.

Vertex height or stature: F/M index = .934; *Acromion height:* F/M index = .934; *Iliospinale height:* F/M index = .935.

All the height measurements exhibit almost the same sex ratios, the females being 93 to 94 per cent as tall from different points of stature as the males. The Tuskegee Negroes are a tall race; the men average 174.9 cm. in stature, the women, 163.3 cm. That is somewhat more than the Dutch for whom the corresponding values, 173.2 and 161.8 cm., were obtained. The sex ratio, however, is almost exactly the same, F/M index for the Dutch being .935. It is also similar for the racial groups in Jamaica, the F/M indices being .928, .933 and .929. This clearly demonstrates that the sex difference in stature is very close among the various racial groups examined.

For acromion height the F/M index in the Tuskegee amounts to .934 (same value as for the stature as a whole), in the Dutch to .933. For iliospinal height the F/M index is considerably lower for the Dutch than for the Tuskegee. In the Tuskegee it is .935, in the Dutch of Holland, only .918. This strikingly low value of the sex ratio in the Dutch people can only mean that the Dutch women have relatively shorter legs (+ pelvis) when compared to the men than the Negro females. This becomes still more distinct if the absolute values are observed. In the present investigation the average iliospinal height for Negro males and females has been found to be 101.0 and 94.4 cm., respectively; in the Dutch these averages are computed at 98.6 cm. for the males and 90.6 cm. for the females. Thus, although both sexes of Tuskegee Negroes have longer legs or, more exactly, greater values of iliospinal height, the sex difference is larger for the Dutch. The differing F/M index of iliospinal height demonstrates best the different body proportions in both races, especially for the female body. Trunk + legs are almost the same size, but legs + pelvis (iliospinal height) are considerably shorter in Dutch women.

Head and neck: F/M index = .937.

To the trunk measurements also belongs the height of head and neck, which is indirectly obtained by subtracting the suprasternale

height from the stature. The absolute values in the Tuskegee group are 31.19 cm. for the males and 29.24 cm. for females. Thus, the F/M index amounts to .937; this index in the Dutch was .943. The corresponding F/M indices of the Jamaica Blacks, Browns, and Whites were .932, .947 and .943, respectively.

Sitting height: F/M index = .941.

The F/M index of the sitting height of the Tuskegee is .941 and of the Dutch, .942. Although there is hardly any racial difference in the sex ratio, the differences of the absolute values of the means are considerable and statistically significant. The mean for the male Tuskegee is 89.0 ± .21 cm. for the female Tuskegee, 83.7 ± .21 cm., the corresponding values for the Dutch were 91.3 ± .31 and 86.0 ± .39 cm. Thus the differences between the races are 2.3 ± .37 cm. for the male sex, and 2.3 ± .44 cm. for the female sex. It is obvious that the Negro race develops a shorter trunk in both sexes than the White race; but the sex ratio is in both races approximately the same.

Relative sitting height: F/M index = 1.008.

The relative sitting height for the male Tuskegee is 50.9 per cent and for the females, 51.3 per cent; therefore the sex ratio is somewhat above 1, which implies that the women have somewhat shorter legs in relation to the whole stature than the men. In the Dutch the respective values were 52.3 and 52.9 per cent, i.e. a sex ratio of 1.011. Both percentages are higher than for the Tuskegee, thus implying for both sexes a greater sitting height or shorter legs. The sex ratio for the Dutch, however, does not differ essentially from the Tuskegee, which can easily be realized if one computes an error of the ratio, i.e. an error of a function.[4] The probable error of the F/M index of 1.008 for the Tuskegee is then .003, and therefore a value of 1.011 is within the limits of a single error. The results in relative sitting height for the races in Jamaica are similar insofar as they show very definitely a higher percentage for the Whites than for Blacks and Browns in both sexes.

Intercristal breadth: F/M index = .955; *Interspinal breadth:* F/M index = .955.

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[4] This formula is ϵ (ratio) $= l \sqrt{\frac{Ex^2}{x} + \frac{Ey^2}{y}}$ where $l = \frac{x}{y}$ is the ratio between the two means x and y, Ex and Ey are the errors of the means. See Tippet's *Methods of Statistics*, p. 88 (10).

The highest F/M index in measurements of the trunk are reached for intercristal breadth and interspinal breadth, if only the absolute dimensions are considered and the relative proportions (body indices) are disregarded. The high sex ratio of .955 shows that the intercristal measurements for the Negro women of Tuskegee are nearer those for the men than the stature measurements, but still have not yet reached the absolute values. For intercristal breadth there are 28.92 cm. in males and 27.62 cm. in females. These measurements are different, however, for the Dutch people of Holland. The respective values for them are 30.0 and 31.9 cm. Thus, their absolute values are not only considerably higher in both sexes, especially for women, but the absolute values of this dimension for the Dutch women exceed those of men. Thus, the F/M index in the Dutch Whites is 1.062 for intercristal breadth and 1.041 for interspinal breadth. This shows a very different construction of the trunk in these two groups. The broader pelvis of the Dutch women may be partly due to the fact that they represent mature females. Yet the Negro men also show a difference, although a smaller one, in this respect from the Dutch. This difference of 1.10 ± .22 cm. is large enough to be statistically significant, but here no explanation except that of racial deviations can be given. Similar results were obtained in Jamaica.

$$\frac{\textit{Intercristal breadth}}{\textit{Biacromial breadth}} : \text{F/M index} = 1.058.$$

In the whole series of measurements and indices taken on the trunk the sex ratio of a trunk index obtained by dividing intercristal by biacromial breadth is the only one in the present investigation exceeding markedly unity. It is obvious, consequently, that this sex ratio reveals a particular sexual dimorphism; the measurements for the female sex exhibit in this respect a significantly larger value than those for the male sex. The original percentages for the sexes are 70.64 ± .25 and 74.76 ± .27; the difference of 4.12 ± .37 per cent is highly significant, as it is 11 times its probable error. The sexual dimorphism is still more outstanding in the Dutch, the F/M index being 1.145 and the percentages for the males and females, 75.3 and 86.2 respectively. Thus the females in general have a broader pelvis when expressed in terms of shoulder breadth than the males. This is true of both races. The corresponding F/M indices for the Blacks and Browns of Jamaica amount to 1.102 and 1.075, and lie again between the values of the Tuskegee and Dutch. This sex ratio indicates, indeed, "one of the

most obvious of secondary sex characters in the proportions of the trunk" (Davenport and Steggerda, *l.c.* p. 71 (4)).

Summary on the trunk sex ratio

The sexes differ mostly in weight as indicated by the low value, .797, of the F/M index. Although body weight is dependent very much on growth in length, the F/M index in stature (.934) is much higher than in weight. Apart from the sexual dimorphism, it also indicates that the rate of growth in stature and body weight is not proportional. This must be considered for every index of body build that relates body weight to stature. The Tuskegee women weigh only about 80 per cent as much as the men, but in stature they are only 7 per cent smaller.

The different chest dimensions also show a relatively low F/M index in this group, which demonstrates that the females are less stocky than the males in every direction of the chest. This sex difference, especially in chest girth, is much larger than for the Dutch Whites.

The most characteristic difference in the sexes is the configuration of the pelvis, best shown by the sex ratio of a trunk index obtained by dividing the intercristal breadth by the shoulder breadth. In this respect the females develop significantly higher percentages than the males, the F/M index being 1.058 in the present sample. In the Dutch group it was as high as 1.145, indicating a still more distinctive sexual dimorphism.

APPENDAGES

In Table 3 the female-male indices for measurements taken on the appendages are arranged by order of their magnitude.

Upper arm girth: F/M index = .834; *Lower arm girth:* F/M = .849.

The lowest values of the F/M indices on the appendages are found in the upper and lower arm girth. This is another characteristic, and certainly significant sex difference, indicating the different development of the arm muscles in the sexes. The absolute values of the differences amount to around 4.9 cm. for the upper arm girth and 4.2 cm. for the lower arm girth. This sex difference in the Tuskegee Negroes is much greater than in the Dutch Whites, for whom the corresponding differences are .8 cm. for the upper and 1.8 cm. for the lower arm. The corresponding F/M ratios for the Dutch Whites are .972 and

TABLE 3

Physical measurements of 100 male and 100 female Tuskegee Negroes: Appendages
Arrangement of the female-male ratios in order of magnitude.

MEASUREMENTS OF APPENDAGES	F/M INDEX	DIFFERENCE / P.E. OF DIFFERENCE
Upper arm girth	.834	21.3
Lower arm girth	.849	25.4
Hand breadth	.876	24.1
Foot breadth	.909	14.8
Foot length	.910	19.9
Tibiale height	.923	14.5
Hand length	.924	16.1
Leg length I (vertex height-sitting height)	.924	14.6
Span	.925	17.5
Upper arm length	.925	13.6
Total arm length (acromion-dactylion)	.926	15.7
Net arm length (acromion-stylion)	.929	14.0
Lower arm length	.932	11.7
Radiale height	.936	13.7
Stylion height	.937	12.4
Calf girth	.938	10.0
Leg length II (iliospinale height–35 or 45 mm.)	.943	12.3
Dactylion height	.943	9.4
$\frac{\text{Hand breadth}}{\text{Hand length}}$	.952	9.6
$\frac{\text{Foot breadth}}{\text{Foot length}}$	.974	4.8
$\frac{\text{Span}}{\text{Stature}}$	.984	6.9
$\frac{\text{Acromion-stylion}}{\text{Stature}}$	.997	.9
$\frac{\text{Upper arm length}}{\text{Arm length (acrom.-sty.)}}$	.998	.9
$\frac{\text{Upper arm length}}{\text{Total arm (acrom.-dact.)}}$	1.001	.6
$\frac{\text{Lower arm length}}{\text{Arm length (acrom.-sty.)}}$	1.003	.9
$\frac{\text{Lower arm length}}{\text{Total arm (acrom.-dact.)}}$	1.006	1.6
$\frac{\text{Lower arm}}{\text{Upper arm}}$ (brachial index)	1.006	1.1

.933. Thus, the measurements for mature Dutch women reach, especially for the upper arm girth, almost the values of the men, the difference being not quite twice its probable error.

Hand breadth: F/M index = .876; *Hand length:* F/M index = .924; *Hand index:* F/M index = .952.

The next lowest F/M index is for hand breadth. The low value of .876 makes it obvious that the Tuskegee females have narrower hands than the males even when the smaller stature is considered. The sex difference is not so distinct in hand length. Therefore the sex ratio of the hand index, which is given by the percentage of hand breadth divided by hand length, goes further up but is still below unity, the F/M index being .952. The sex ratios in the Dutch group are very similar, being .879, .910 and .970 respectively. However, all the absolute values of the Dutch Whites were greater than for the Tuskegee Negroes as the following summary makes clear:

	Hand breadth in cm.		*Hand length in cm.*	
	Males	Females	Males	Females
Tuskegee	9.14±.03	8.01±.03	20.78±.07	19.21±.06
Dutch	9.64±.04	8.47±.05	21.34±.09	19.43±.09

Foot breadth: F/M index = .909; *Foot length:* F/M index = .910; *Foot index:* F/M index = .974.

The sex ratios for the dimensions of the foot resemble those of the hand. Females, of course, have smaller and narrower feet than the males; both F/M indices for breadth and length of the foot are below the F/M index for the whole stature. Since both values of the F/M index are practically the same, the foot index for males and females (foot breadth in per cent of foot length) must be nearly the same, too, and the F/M index of the foot index close to 1. For the Dutch the value even exceeded unity, F/M index being 1.033. This means that the Dutch women had relatively broader and shorter feet than the men. The absolute values of the foot dimensions for both racial groups are given in the following summary:

	Foot breadth in cm.		*Foot length in cm.*	
	Males	Females	Males	Females
Tuskegee	9.43±.04	8.57±.04	27.42±.09	24.95±.08
Dutch	9.56±.07	8.99±.08	26.62±.11	24.19±.11

It is to be noticed that the Dutch, especially the women, have broader feet than the Tuskegee, but both sexes have distinctly shorter ones. This characteristic racial difference is noticeable, since it is consistent in all four means and since both racial groups are of nearly the same stature.

Tibiale height: F/M index = .923; *Leg length I* (vertex height-sitting height) : F/M index = .924; *Leg length II* (iliospinale height—45 or 35 mm.) : F/M index = .943.

The sex ratios of these height measurements do not furnish much new information; the F/M indices of tibiale height and leg length, which are somewhat below that of the whole stature, indicate the relatively shorter lower extremity of the female sex. However, the leg length estimated in this way (by subtracting sitting height from vertex height) was found to be significantly greater than for the Dutch group. For the Negroes these values (see Table 1) were 85.9 cm. in the males and 79.4 cm. in the females, for the Whites 81.8 and 75.1 cm. respectively.

Another and more accurate method of obtaining leg length as described by Martin (12) was used by subtracting 45 and 35 mm., respectively, from iliospinal height for males and females. The F/M index for this dimension is higher than the preceding value but very close to the sex ratio for iliospinal height as a whole (see measurements on the trunk). The leg length obtained by this method is considerably greater, 96.5 cm. for males and 91.0 cm. for females, i.e. by 10.6 and 11.6 cm. respectively; for the Dutch these values were 94.2 and 86.1 cm.

Radiale height: F/M index = .936; *Stylion height:* F/M index = .937; *Dactylion height:* F/M index = .943.

The absolute values of some more height measurements at different points of the body are given in Table 3. These dimensions have a scientific interest for comparative studies; they also serve the practical purpose by subtraction from acromion height and from each other of checking the direct measurements taken on the arm. It may be mentioned that the values of the F/M index almost coincide with the sex ratios for stature or lie within the limits of a single error of them.

Calf girth: F/M index = .938.

The F/M index for calf girth is close to that of stature, but it

is much higher than the sex ratio for arm girth. This ratio reveals that, when compared with the male, the development of the muscular gastrocnemius in the Tuskegee female is much more proportionate than that of the arm muscle. The relations resemble those of the racial groups in Jamaica. For the Dutch the corresponding data are missing. The absolute values of calf girth are 36.23 ± .159 cm. in men and 33.97 ± .161 cm. in women, the difference being 2.26 ± .226 cm. or exactly ten times its probable error.

Upper arm length: F/M index = .925; *Total arm length* (acromion-dactyloin): F/M index = .926; *Net arm length* (acromion-stylion): F/M index = .929; *Lower arm length:* F/M index = .932.

The female/male index is about the same for the different arm dimensions. This means that the body proportions for the two sexes vary very little in this respect; they all are slightly below the sex ratio for stature but mostly within a single probable error; i.e. the probable error for the lowest sex ratio in this series, .925 for upper arm length, amounts to .0054, so that this ratio plus one probable error still lies within the range of the highest ratio, .932 for lower arm length, minus one probable error.

These arm proportions are very different from the Dutch, for whom the F/M index of the upper arm length is only .901, lower arm .962, and total arm length .917. Thus the Dutch women have, in comparison to the men, a smaller upper arm and a larger lower arm than the Tuskegee women. The absolute values of the means are given in the following summary for both races:

	Upper arm length in cm.		*Lower arm length in cm.*	
	Males	Females	Males	Females
Tuskegee	33.12±.12	30.63±.14	26.25±.10	24.47±.11
Dutch	32.50±.17	29.30±.23	23.09±.17	22.21±.15

These values clearly demonstrate that the Negroes have longer arms than the Whites in both sexes. This race difference is greater for the lower arm, amounting to 3.16 and 2.26 cm. for males and females, respectively, than for the upper arm, the racial differences of which are .62 and 1.33 cm. The long arms of the black race, especially forearms, have been reported by many authors (see Hrdlička (11), Martin (12)). The sum of upper and lower arm length gives the net arm length (acromion-stylion) which is of course considerably

greater for the Tuskegee than for the Dutch. Still more interesting in this respect is the total arm length (acromion-dactylion) in which the hand is included. The mean values for this dimension are 80.4 and 74.4 cm. for the Tuskegee males and females as compared with 77.4 and 71.0 cm. for the Dutch, correspondingly. The sex differences, as well as the race differences, are statistically beyond the limits of mere chance fluctuations.

$$\frac{\textit{Arm length}}{\textit{Stature}}\ \text{(acromion-stylion)}: \text{F/M index} = .997;$$

$$\frac{\textit{Upper arm length}}{\textit{Arm length}\ \text{(acromion-stylion)}}: \text{F/M index} = .998;$$

$$\frac{\textit{Upper arm length}}{\textit{Total arm}\ \text{(acromion-dactylion)}}: \text{F/M index} = 1.001;$$

$$\frac{\textit{Lower arm length}}{\textit{Arm length}\ \text{(acromion-stylion)}}: \text{F/M index} = 1.003;$$

$$\frac{\textit{Lower arm length}}{\textit{Total arm}\ \text{(acromion-dactylion)}}: \text{F/M index} = 1.006;$$

$$\frac{\textit{Lower arm}}{\textit{Upper arm}}\ \text{(brachial index)}: \text{F/M index} = 1.006.$$

Since the sex ratios of all the dimensions discussed in the foregoing paragraph are almost the same, it is not surprising that the different F/M indices of the body proportions or body indices vary very little from 1. It is obvious that the more proportionate the various dimensions for the two sexes become the nearer the sex ratio of the proportions approaches unity. The measurements for the Dutch are very different, the brachial index (lower arm length in percent of the upper arm length) resulting in a sex ratio of 1.068, according to the F/M indices of the separate dimensions (.962 for lower arm length, .901 for upper arm length). This is in sharp contrast to the corresponding value of the Tuskegee Negro, the F/M index of their brachial index being 1.006. Thus the sex differentiation of the Dutch Whites is much more apparent in this respect, or the Tuskegee Negroes develop more proportionate dimensions in the sexes.

There is another point worth mentioning regarding the brachial index. The absolute values of the percentages for the Tuskegee are 79.40 in the males and 79.85 in the females, which are almost 80 per cent of the upper arm length. As the corresponding values of the Whites

are reported as 73.33 and 75.23, they have relatively shorter lower arms in comparison to the upper arms than the Negroes. Quoting from Davenport and Steggerda (p. 103 (4)) in regard to the meaning of the brachial index:

"The brachial index varies greatly in the different primates, being about 107 in *Hylobates*, 96 in Orang-utan, 94 in Chimpanzee, 83 in Gorilla and under 80 in humans."

In the quoted study the Jamaica Blacks have a distinctly higher brachial index, 77.89 for males and 77.80 for females, than the Jamaica Whites, 75.76 and 74.23 respectively. The race difference is still more emphasized in the present study, since the Tuskegee reach almost 80 per cent. In view of the fact that the brachial index tends to diminish in the Whites with increasing age during development of the child, one might say that the high index of the Blacks is a persisting juvenile condition.

Span: F/M index $= .925$; $\frac{Span}{Stature}$: F/M index $= .984$.

The sex ratio for span is somewhat below that of stature, therefore the same ratio for relative span (span expressed in terms of the stature) must be somewhat below unity for both sexes. This means that the females have a shorter span because they have the shorter arms. Even when the different vertex heights of the sexes are taken into account, the relative span shows a somewhat lower percentage for the female sex. The percentages in our sample are for males 106.24 ± .15 and for females, 104.58 ± .19. The percentage values make it clear that the maximum arm stretch (or span) of the Tuskegee is significantly larger than the stature in both sexes. Hrdlička (11) gives in his study on white old Americans as low values as 102.6 in males, 99.6 in females. Since long arms are a Negro characteristic, the values of absolute and relative span are higher than in the Whites. This is shown for the Dutch and Tuskegee in the following summary:

	Span in cm.		*Relative span in per cent*	
	Males	Females	Males	Females
Tuskegee	184.75±.54	170.91±.58	106.24±.15	104.58±.19
Dutch	178.89±.62	163.07±.57	103.28±.21	100.37±.28

The sex difference is again somewhat more distinct in the Whites. The difference of absolute arm stretch for the Whites is nearly 16

cm., for the Negroes not quite 14 cm. All the relations in the racial groups in Jamaica were similar.

Summary on the appendages

Upper extremity:

The sex differentiation is most distinct in arm girth, the F/M index being lowest in upper arm girth, .834 (much lower than in calf girth). The Tuskegee women also have narrower hands than the males, even when the difference in stature is considered. The F/M index of hand breadth is as low as .876. The sex difference is not so distinct in hand length, the F/M index being .924. The arm dimensions are rather proportionate in both sexes of the Tuskegee Negroes. Therefore, the sex ratios of the different arm proportions (arm indices) are all alike and around 1. This equality is still more striking when compared with the Whites. Thus the brachial index gives a F/M index for the Whites of 1.068, for the Negroes only 1.006. The Dutch women have relatively shorter upper and longer lower arms then the men. However, both sexes of the Negroes have significantly longer arms than the Whites, particularly longer lower arms. This is a significant characteristic of the races. For the same reason absolute and relative span is considerably larger in the Tuskegee Negro than in the Dutch Whites. The females exhibit lower values in arm stretch in both races.

Lower extremity:

The Tuskegee females have smaller and narrower feet than the males, the sex ratio being below that for the stature as a whole. This sex differentiation is different in the Dutch whose women have relatively broader feet than the men. (The F/M index of the foot index is below 1 in the Tuskegee, above 1 in the Dutch). Leg length, as taken by subtracting sitting height from vertex height, gives lower values in the females, the F/M index being .924 and very close to that of tibiale height. Leg length as estimated by subtracting 45 and 35 mm., respectively, from iliospinal height of men and women gives a considerably higher F/M index, .943, or a relative increase of leg length for the females probably due to the inclusion of the pelvis. Compared to the Dutch, however, both methods show that the Negroes have, in both sexes, the longer legs.

HEAD

The female/male indices of the measurements on the head do not show such a wide variation as the trunk and appendages measurements, as will be easily realized by glancing at Table 4 in which the indices are arranged in order of rank.

TABLE 4

Physical measurements of 100 male and 100 female Tuskegee Negroes: Head

Arrangement of the female-male ratios in order of magnitude.

MEASUREMENTS OF HEAD	F/M INDEX	DIFFERENCE / P.E. OF DIFFERENCE
Trichion to gnathion	.927	15.3
Mouth width	.928	11.3
Nasal breadth	.934	10.7
Head width	.946	17.2
Bizygomatic breadth	.946	15.2
Nasion to gnathion	.946	11.7
Head length	.948	16.2
Bigonial breadth	.952	11.7
Ear breadth	.958	6.9
Nasion to stomion	.961	7.2
Ear length	.964	6.3
Nasal breadth / Nasal length	.964	4.6
Nasion to subnasion	.970	4.8
Minimum frontal breadth	.974	6.4
Head girth	.978	7.5
Ear breadth / Ear length	.996	.6
Head width / Head length	.998	.6
Nasion to gnathion / Bizygomatic breadth	.998	.3
Interpupillary distance / Head width	1.023	5.0
Minimum frontal breadth / Head width	1.029	7.8

Trichion to gnathion: F/M index = .927; *Nasion to gnathion:* F/M index = .964.

The lowest value in this respect is the F/M index for length of the face, trichion to gnathion; but even this ratio is not much below that of stature. Thus, the females have only a slightly shorter face than the males in terms of stature. However, the distance from nasion to gnathion has a F/M index somewhat above that of stature. It is inverse with the Dutch, the respective F/M indices being .938 and .921. This means that the Tuskegee females have a relatively smaller forehead height (distance from trichion to nasion). The means as compared to those of the Dutch are as follows:

	Trichion to gnathion in mm.		*Nasion to gnathion in mm.*	
	Males	Females	Males	Females
Tuskegee	191.7±.69	177.7±.61	132.9±.48	125.6±.40
Dutch	187.8±.81	176.1±.78	122.9±.66	113.3±.57

From the summary it is obvious that the difference of the whole length of the face in the two races is small and hardly significant; but the distance from nasion to gnathion alone is in both sexes significantly larger in the Tuskegee, the difference being 10 and 12 mm., respectively, thus leaving less space for the rest of the length of the face (forehead). The sex differences are significant in both races.

Mouth width: F/M index = .928.

The width of the mouth is in both sexes of the Tuskegee nearly proportionate, the F/M index being close to that of stature. The means, 54.7 mm. in males and 50.7 in females, show, of course, a significant difference as may be seen from the main table. It is worth mentioning that in this instance the sex differentiation for the Dutch proves much smaller, the F/M index reaching .980. The Dutch women, consequently, have a relatively wide mouth, as the absolute values of the means make evident, 54.3 mm. in males and 53.2 mm. in females (Steggerda (3)).

Nasal breadth: F/M index = .934; *Nasion to stomion:* F/M index = .961; *Nasion to subnasion:* F/M index = .970; $\frac{\textit{Nasal breadth}}{\textit{Nasal length}}$ (nasal index); F/M index = .964.

For nasal breadth the sexes are proportionate, the sex ratio being the same as for stature and very similar to that in the Dutch people.

For the distance from the nasion to stomion the Tuskegee F/M index goes up to .961, and to .970 for nasion to subnasion (length of the nose). Thus the Tuskegee girls have relatively longer noses, when compared to the stature, than the boys; it is not so with the Dutch for whom both F/M indices are considerably lower (.933 and .921, respectively).

Of greater interest from the racial point of view are the mean values of nose breadth and nose length, and especially the nasal index which is the quotient of the greatest breadth by the length of the nose in per cent. These values are given in the following summary:

	Tuskegee		*Dutch*	
	Males	Females	Males	Females
Nasal breadth in mm...	43.9±.20	41.0±.18	35.1±.25	32.9±.31
Nasal length in mm.....	61.2±.28	59.3±.27	56.1±.41	51.7±.39
Nasal index in per cent	72.1±.42	69.5±.37	62.5±.81	63.4±.83

It is evident that the Tuskegee Negroes have the greater dimension in both length and breadth of the nose; all the racial differences are statistically significant. However, nasal breadth is, when compared to the Dutch, relatively greater than nasal length, as demonstrated by the higher values of the nasal index in both sexes.

It is remarkable, in this respect, that the colored races in Jamaica have a still higher nasal index; the values (per cent) are 95.0 for Blacks, 88.4 for Browns and 67.6 for Whites in the male sex; correspondingly, 87.0, 82.4 and 66.2 in the female sex. That the nasal index in both Jamaica colored groups is that much higher than in the Tuskegee Negro group is primarily due to the much longer nose of the Tuskegee Negro, while the breadth of the nose is almost identical with the values in Jamaica. This observation clearly shows that nasal index, an important yardstick for racial differentiation between Negroes and Whites, may also differ in various sub-groups of the colored race, as well as in various grades of hybridization. Mention should be made also of the great technical difficulty in locating nasion. A slight error here in technique will cause a great difference in the final nasal index.

Ear breadth: F/M index = .958; *Ear length:* F/M index = .964; $\frac{\textit{Ear breadth}}{\textit{Ear length}}$ (ear index): F/M index = .996.

The sex ratios for breadth and length of the ear (also called pinna) are very close and somewhat above that of stature. The sex ratio of the ear index (ear breadth in per cent of ear length) approaches unity. This sex resemblance again is more distinct than in the Dutch for whom the corresponding F/M indices are .939, .946 and .980. This can be easily realized from the following values of the means:

	Tuskegee		*Dutch*	
	Males	**Females**	**Males**	**Females**
Ear breadth in mm.....	37.8±.18	36.2±.15	36.0±.29	33.8±.28
Ear length in mm.....	61.1±.24	58.9±.26	66.6±.41	63.1±.61
Ear index in per cent..	61.9±.30	61.6±.28	54.5±.47	53.3±.60

The ear index is considerably higher in the Negro race than in the White, and this indicates a more circular pinna form.

Bizygomatic breadth: F/M index = .946; *Bigonial breadth:* F/M index = .952; *Minimum frontal breadth:* F/M index = .974.

The F/M indices for the distance between the two zygomatic arches (bizygomatic breadth), the angles of the lower jaw (bigonial breadth), and minimum frontal breadth (the hollows to the side of the orbits) are all somewhat above the corresponding sex ratio for stature, especially the index for frontal breadth. The Tuskegee females have relatively broader faces (when related to the stature as standard) than the males. These sex relations are similar to those of the Dutch, the corresponding F/M indices being .963, .961 and .987. Thus the Dutch women, also, have somewhat higher values or relatively broader faces than the men.

$\frac{\textit{Nasion to gnathion}}{\textit{Bizgomatic breadth}}$ (facial index): F/M index = .998.

Since the bizygomatic breadth and the distance from nasion to gnathion have the same F/M index (.946), a facial index obtained by the quotient of both dimensions must give the same percentages in both sexes. The mean values are 94.88 in males and 94.72 in females for the present investigation; hence, the F/M index is very close to 1. The corresponding F/M ratios for the Dutch are .921 for nasion

to gnathion and .963 for bizygomatic breadth. Therefore, the sex ratio for the facial index, .956, indicates the greater sex differentiation of the Dutch.

Head width: F/M index = .946; *Head length:* F/M index = .948; *Head girth:* F/M index = .978; $\frac{\textit{Head width}}{\textit{Head length}}$ (cephalic index): F/M index = .998.

The sex ratios for head width (or breadth) and head length are almost the same. Therefore the quotient of these dimensions, which is the well-known cephalic index, must have a F/M index very close to unity (.998). This is true for most racial groups including the present Dutch. The sex ratios of the head girth for both races are very close, the F/M index of the Tuskegee Negro being .978, of the Dutch Whites .980. A concrete insight into the relations of both racial groups is given by the absolute means.

	Tuskegee		*Dutch*	
	Males	Females	Males	Females
Head width in mm.....	152.8± .37	144.5± .30	152.5± .54	148.2± .36
Head length in mm.....	199.7± .44	189.3± .46	192.6± .56	185.2± .40
Head girth in mm.....	576.9±1.22	564.0±1.23	563.5±1.60	552.2±2.10
Cephalic index in per cent	76.6± .21	76.4± .20	79.3± .31	80.1± .23

The cephalic index makes it obvious that the Tuskegee have a slightly longer skull, both sexes showing practically the same per cent value. The Dutch Whites, especially the women, approach the brachycephalic type when using the common classification of head forms: dolichocephalic, index up to 75, mesocephalic, above 75 to 80, and brachycephalic, above 80.

$\frac{\textit{Interpupillary distance}}{\textit{Head width}}$: F/M index = 1.023; $\frac{\textit{Minimum frontal breadth}}{\textit{Head width}}$: F/M index = 1.029.

The F/M ratios of both indices are approximate and significantly above 1. Thus, they show that in terms of head width the women have a relatively larger distance between pupils and a relatively larger frontal breadth. This confirms former results that the women have, in general, relatively broader faces than the men. Comparable data for the Dutch are not available.

Right or left hand grip: F/M index = .554; *Age:* F/M index = .948; *Eye color:* F/M index = 1.004.

Some F/M indices are added which do not fit into the classifications of the other measurements. (The means are given at the close of Table 1; the index values are annexed at the end of Table 2). Of those measured at Tuskegee College, average age is given as 21.15 years for males and 20.05 years for females. For eye color there is no sex dimorphism. The sex difference is greatest in hand grip (for both hands), the F/M index of .544 being the lowest of all sex ratios. It is a physiological test of bodily strength and shows that the muscle strength of the arms in the Tuskegee College girls is not much more than half that of the boys. It complements to some degree the low sex ratio in arm girth (lowest of all anatomical body dimensions) and is in almost exact concordance with Hrdlička's findings in Old Americans.

Summary on the head

Sex differentiation is not as great in dimensions of the head as in those of the trunk and the appendages. This is clearly demonstrated by the relatively small range of the F/M indices. The Tuskegee women have a slightly shorter face, i.e. distance from trichion to gnathion, than the males (when compared to the stature); but they have a relatively greater distance from nasion to gnathion and, hence, a shorter forehead. They also have relatively longer noses than the men. The nasal index is larger in the Tuskegee males; thus, the males have broader noses than the females in terms of nasal length. But both sexes have a definitely higher nasal index than the Dutch. In the shape of the ear there is no striking sex dimorphism; but both sexes have a more circular form of the ear than the Dutch, which is another characteristic racial differentiation. The Tuskegee females have relatively broader faces than the males; however, the Dutch women have still broader faces, as indicated by the higher F/M indices of bizygomatic breadth, bigonial breadth, and frontal breadth. As regards the cephalic index, there is no sex differentiation in the Tuskegee group; both sexes have a more mesocephalic skull as compared to the more brachycephalic type of the Dutch.

In Figure 1 an attempt has been made to illustrate the sexual dimorphism as well as racial differentiation. The drawings were made by Miss A. M. Hellmer to whom the authors express their gratitude.

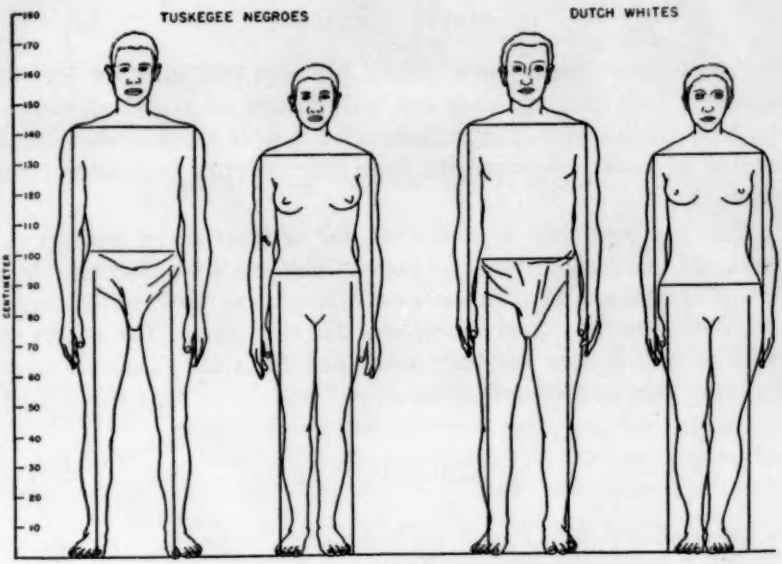

Fig. 1 b

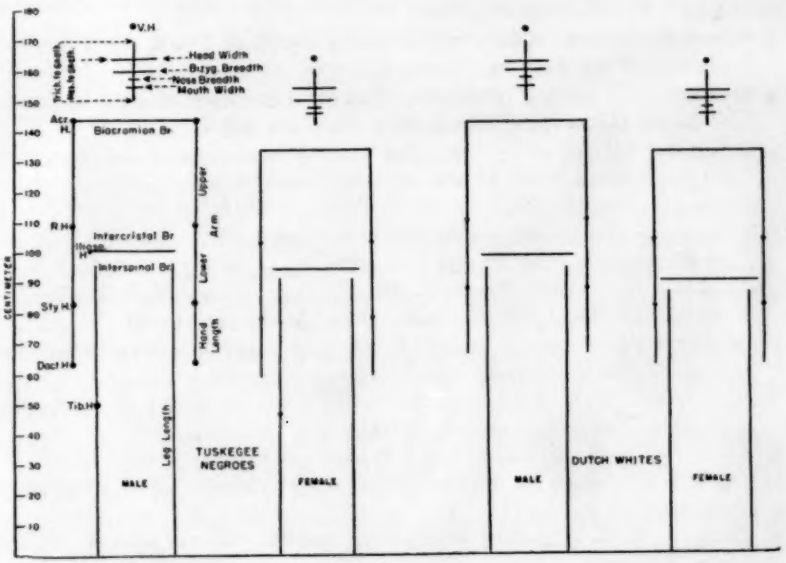

FIG. 1 a, b. SEXUAL DIMORPHISM AND RACIAL DIFFERENTIATION EXHIBITED IN TUSKEGEE NEGROES AND DUTCH WHITES

GENERAL SUMMARY

A sex ratio (female/male index) has been computed for the most important body measurements and body indices on trunk, appendages, and head dimensions. The various index figures are presented for the purpose of better describing the finer differences in body build of the sexes.

This has been done by comparing the anthropometric findings in a sample of two racial groups (American Negroes from Tuskegee Institute, Alabama, and Dutch-American Whites from Holland, Michigan) with respect to the sexual dimorphism for each item. The results and statistical significance for both sexes and races are discussed in the text under the respective headings.

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RACIAL FUSION AMONG THE CALIFORNIA AND NEVADA INDIANS

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I

IN a series of recent papers the course of racial adjustment by Pacific Coast Indians has been discussed from the standpoint of environmental adaptation.[1] It has been shown that these aboriginal peoples have made considerable progress during the past century with respect to dietary habits, urbanization and certain social customs such as marriage and divorce. Ecological changes, however, are likely to be associated with alteration in genetic constitution, with varying degrees of racial fusion. Hence it becomes of significance to learn if possible to what extent there has been admixture of Caucasian with Indian blood.

II

The pertinent information is available in the form of several quite adequate censuses. The first, and most comprehensive, is that of 1928 in which the attempt was made to enumerate all the Indians in California.[2] In conjunction with other data the degree of blood for each

[1] Cook, S. F. The mechanism and extent of dietary adaptation among certain groups of California and Nevada Indians. *Univ. Calif. Publ., Ibero-Americana,* no. 18, 1941.

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[2] This census is described in detail in an earlier paper (Migration and urbanization, etc.) to which reference may be made.

individual was tabulated. In addition there are several censuses taken by resident agents at intervals during the past forty years.[3] Not all of these are complete but those for Hupa Valley in 1910, 1930, 1940, for Carson Agency for 1940, and for the Mission Agency in 1940 state degree of blood for each person enumerated. In the 1928 comprehensive census and in all others taken within recent years the degree of blood is expressed as an exact fraction—½, ¼, etc. Since such notation is cumbersome for purposes of calculation I have converted it to terms of simple percentage, calling full Indian blood 100 per cent, half blood 50 per cent, etc.

The accuracy with which a white man can determine the precise degree of blood in a given Indian has always been subject to considerable debate. Where records are available they may serve as a valid criterion. Otherwise the word of the Indian, his relatives and friends, must be accepted. Granting that the individual may be ignorant of his ancestry or may be prone to falsification, nevertheless the enumerators have been consistently careful to utilize all sources of evidence and arrive at a reasonably close approximation. In particular the agency employees who customarily perform this task know their Indians personally and are not likely to be misled seriously by false statements. Moreover, in the statistical sense errors which are introduced are random. I know of no generalized tendency for Indians to represent themselves as possessing more or less native blood than is actually the case. Finally we are forced to accept the data of the censuses for what they are worth since there is no better source of information available. On the whole they may be regarded as quite reliable.

The extent of miscegenation between any two racial stocks obviously depends upon a host of factors, physical and social, which are so interrelated as to defy any final and complete analysis. We can at best select a few and test them with respect to the factual material at hand.

1. Perhaps the least common denominator applicable to all such situations is physical propinquity. This may be expressed in terms of population density for it is obvious that if both races are present in large numbers over a small area more crossings will occur than if either one or both is sparsely represented. There is no numerically signifi-

[3] These records were kindly put at the disposal of the author by the agents in charge of the Hupa Valley, Sacramento, Carson, and Mission Agencies.

cant relation between degree of blood and white density alone, but an association between degree of blood and the ratio of Indian to white density based on county populations yields a chi-square value of 9.84. Since this is moderately significant, one may conclude that density as such is operating to increase racial fusion.

2. Irrespective of the crude densities, if the Indian population is in any way segregated from the adjacent whites the normal principle of random contact will no longer hold with undiminished validity. The reservation system constitutes such a segregation.[4] Furthermore, numerous small bodies of natives may be settled in geographically isolated spots within otherwise heavily settled areas, and thus fail to make the contacts which would be assumed from the basic density data.

The effect of isolation may be tested by separating the California tribes into three arbitrary divisions. In the first may be placed those tribes which have been closely under federal supervision—on and off actual reservations—even though they were located in thickly inhabited regions.[5] The second will include those tribes geographically isolated, whether or not under federal supervision and the third will consist of the remainder, those who have been isolated in neither the political nor geographical sense. The mean degree of blood in 1928 for the three divisions was: first 67.0 per cent, second 76.9 per cent and third 51.4 per cent. There appears, therefore, a rough but distinct correspondence between degree of isolation and extent of racial mixture.

3. A third possible factor in determining fusion is the social condition of the individual tribe. If an aboriginal unit is still moderately intact, without serious losses in number, with many of the primitive institutions in force we would expect to find in it less dilution with

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[4] The reservation system implies more than the mere enclosure of an Indian group upon a plot of land with a fence around it. Rather it embodies all forms of paternal oversight on the part of the government to the end that the needs of the Indians shall be so satisfied that physical and social contact with the whites becomes unnecessary.

[5] The first group includes: Yurok, Hupa, Pomo, Yokuts, Western Mono, Cahuilla and descendants of Missions Santa Ynez, San Luis Rey, San Juan Capistrano, and San Diego.

The second group includes: Karok, Achomawi, Paiute, Washo, Shoshone, and Yuma.

The third includes: Tolowa, Wiyot, Athabascan remnants, Chimariko, Wylackie, Yuki, Shasta, Maidu, Miwok, Wintun, Yana, and the Mission Indians from Sonoma to Los Angeles.

Caucasian blood than in one which had been violently disrupted and dispersed. The most convenient quantitative index to such disruption is the per cent of the aboriginal population now surviving. Associating the latter with degree of blood a chi-square value of 5.89 is obtained, which indicates a just significant relationship.

III

Although analysis of contemporary conditions can yield some information concerning the factors responsible for racial mixture, it is equally clear that the process must be considered essentially from the historical point of view. Environmental changes of an adaptive nature may, under sufficient pressure, occur with great rapidity—genetic alteration cannot. One must, therefore, attempt to reconstruct the temporal course of racial fusion among the California Indians.

It is both convenient and logical to subdivide the Indian population into five historical categories, rather than treat it as a composite. The first segment (Group I) consists of those tribes which were untouched by white civilization prior to 1848, but were at that time subjected to an inundation of pioneers, particularly gold miners. From 1850 to 1860 they passed through a catastrophic period of physical, economic and social upheaval, subsequent to which the survivors were permitted to settle down in the newly established communities and have existed under fairly stable conditions ever since. This group includes most of the tribes in northern and central California: Tolowa, Yurok, Hupa, Wiyot, Chimariko, Karok, Yuki, other Athabascans, Wylackie, Pomo, Shasta, Maidu, Miwok, Wintun, Yokuts, Mono, and Tulatulabal of Kern River. Collectively they comprise approximately one half the Indian population of the State.

The second segment (Group II) consists of the Atsugewi (Pit Rivers), Washo, Northern Paiute, Eastern Mono (commonly called Paiute), other Shoshoneans, and Yuma. These peoples inhabited the fringes of the Great Basin east of the Cascades, Sierra Nevada, and Colorado desert. They did not meet the white race till 1850, were relatively little disturbed physically and have never had an opportunity to mix freely with large masses of white men.

The third and fourth segments, in contradistinction to the others, were subjected to the Ibero-American civilization of the missions as early as 1770. The coastal natives, and many from the interior, became

what the administrators of the system were pleased to call "reduced" to Christianity. Despite huge losses from disease and social causes the survivors by 1850 had become thoroughly adapted to the pastoral civilization of the time. Subsequent to 1850 the remnants from the missions as far south as San Gabriel at Los Angeles merged unnoticed with the general population and have never been treated as wards by the Indian Service. Their history has thus been in many respects similar to that of other racial groups which did not originate in California but migrated thence. This segment constitutes Group III. Group IV comprises the Indians from the three southern establishments of San Luis Rey, San Juan Capistrano, and San Diego to whom are added the partially missionized Cahuilla. Large in numbers, this group received much attention from the Federal Government which indeed placed most of them on reservations and set up a special agency for them. Thus, unlike Group III, instead of merging easily with the surrounding white population they have been kept rather isolated.

The fifth segment (Group V) is composed of the natives of northern and western Nevada-Paiute, Washo, and Shoshone—who have been under the jurisdiction of the Carson Agency. The history of these Indians resembles that of Group II in that their contact with whites has been limited. Indeed, their isolation in all senses has been even more complete than that of the aborigines living over the line in California.

The genetic differences in the five natural groups or subdivisions can be demonstrated by three methods of analysis. The first consists in breaking down the data to show the percentage of each group having different degrees of blood—see Table 1. The geographically remote groups (II and V) still possess over 75 per cent full bloods, whereas only 16 per cent are found in Group III and 26 per cent in Group I. That the process of mixing has been proceeding for a long time in Group III is indicated by the fact that 5 per cent of these persons are of the fifth mixed generation (1/32 Indian blood) and 5 per cent of the sixth generation (1/64 Indian blood) with a few individuals reporting only 1/128 Indian blood.

The tendency to intermix with the white race is also shown by the distribution within a given generation. Thus if we examine the individuals having 25 and 75 per cent (¼ and ¾) Indian blood we find that the former predominate in Groups I, III and IV, the latter in Groups II and V. Otherwise expressed, in the isolated segments of the population half-breeds tend to marry full-bloods rather than

TABLE 1

Per cent of total population corresponding to different degrees of mixture

GENERATIONS FROM PURE INDIAN BLOOD	0	1	2			3					4								
Per cent Indian blood	100	50	25	75	Total	12.5	37.5	62.5	87.5	Total	6.2	18.7	31.2	43.7	56.2	68.7	81.2	93.7	Total
Group I	26.46	23.51	15.83	10.46	26.29	9.19	4.64	4.07	2.83	20.73	0.92	0.54	0.29	0.43	0.19	0.27	0.25	0.04	2.93
Group II	77.84	9.79	3.59	5.30	8.89	0.65	0.31	0.42	1.85	3.18	0.11	....	0.02	0.02	0.08	....	....	....	0.23
Group III	16.66	23.55	22.45	6.48	28.93	11.17	5.38	0.49	0.39	17.43	2.99	0.59	0.01	0.01	....	....	....	....	3.60
Group IV	42.36	16.41	11.35	7.52	18.87	8.23	3.50	1.84	1.53	15.10	1.77	1.82	0.96	0.46	0.11	0.61	0.07	0.11	5.91
Group V	75.66	9.93	1.81	6.84	8.65	....	0.58	1.59	3.22	5.39	....	....	0.07	....	0.10	0.02	0.10	0.02	0.31

GENERATIONS FROM PURE INDIAN BLOOD	5									6			7	
Per cent Indian blood	3.1	9.3	21.8	28.1	34.3	46.8	53.1	78.1	Total	1.5	10.9	Total	0.7	Total
Group I	...	0.03	...	0.01	...	...	0.02	0.02	0.10	...	...	0.00	...	0.00
Group II	...	...	...	...	...	...	...	...	0.00	...	...	0.00	...	0.00
Group III	4.19	...	...	...	...	...	...	...	4.19	4.99	...	4.99	0.39	0.39
Group IV	0.23	0.35	0.16	...	0.47	0.02	...	...	1.23	...	0.02	0.02	...	0.00
Group V	...	...	...	...	...	...	...	...	0.00	...	...	0.00	...	0.00

whites, whereas among the former mission Indians half-breeds are more likely to marry persons whiter than themselves. This tendency is likewise manifest in subsequent generations. For instance in the third mixed generation the progression in Group III is: 1/8 blood 11.17 per cent, 3/8 blood 5.38 per cent, 5/8 blood 0.49 per cent, and 7/8 blood 0.39 per cent. In Group V the corresponding values are 0.0 per cent, 0.58 per cent, 1.59 per cent, 3.22 per cent. Indeed a general principle is demonstrated, viz. the lower the level of Indian blood in the individual, the greater is the probability of his or her marrying into the white race.

However, in order for this principle to become operative in fact there must be free physical opportunity for the social urge to fulfill itself. The coastal mission Indians of Groups III and IV probably followed identical courses until the late 19th century at which time the former group went on reservations. This threw those persons of low Indian blood into an environment of relatively pure Indian stock and thus retarded their mixture with the whites. Among the non-reservation Indians of Group III no such environmental inhibition was present and they have proceeded to merge more rapidly with the white population. The same considerations apply to Groups II and V although in lesser degree. The tendency to backcross into the full-blooded stock has been somewhat greater in Group V. This is doubtless associated with the more stringent confinement on reservations and the greater geographic isolation to which they have been subjected.

The second method of analysis is ideally the most direct and satisfactory. This is to secure a set of complete censuses for a single group, taken at frequent intervals since the beginning of white settlement. Unfortunately such a set of data does not exist. We possess merely a few fragments. The earliest agency census I have found is that for Hupa Valley in 1890, but not until 1910 was degree of blood stated and then only as "full" and "quarter plus". The other agencies did not record exact degree of blood until some ten years ago. In spite of these restrictions, nevertheless, we can assemble a few items pertaining to the per cent of full bloods and their median ages. These are presented in Table II. In all three cases, the Hupa, Paiute (Western Mono) and Southern Mission, it is clear that the relative number of full bloods is steadily diminishing. Furthermore, in two out of the three cases their median age with respect to that of the entire population is in-

TABLE 2

Data for certain tribes taken from successive censuses

JURISDICTION AND DATE	PER CENT OF FULL BLOODS	MEDIAN AGE OF FULL BLOODS MINUS MEDIAN AGE OF TOTAL POPULATION
Hupa Res., 1910	70.5	7.65
Hupa Res., 1930	37.9	13.25
Hupa Res., 1940	29.3	14.04
Mission Tribes, 1928	53.7	8.36
Mission Agency, 1940	47.1	12.15
Paiute, Mono, and Inyo Cos., 1928	71.2	7.41
Same, Carson Agency Census, 1940	61.2	7.52

creasing. Although no further refinements in calculation are justified these data tend to support the results obtained previously.

The third approach to the problem of historical changes is by analysis of degree of blood with respect to age. The relations are most clearly expressed by determining the mean degree of blood for each age group using five-year intervals. The results are then plotted graphically (see Figs. 1 and 2).

If a pure-blooded population has been exposed to consistent hybridization over a reasonably long period of time, the mean degree of aboriginal blood should be at a maximum among the oldest persons and at a minimum in the youngest. The velocity with which the process has occurred should be indicated by the slope of the line in the plot of age against degree of blood, whereas the vertical distance of the points from the base line is a rough index to the relative extent of hybridization at any given epoch.

In Fig. 1 are plotted the data, using five-year intervals for Groups I to IV. Group V is omitted since it substantially coincides with Group II. Consider Group II, which by other methods has been shown to have undergone the least change. The oldest age category to possess 100 per cent Indian blood is that centering around 67.5 years. Since the

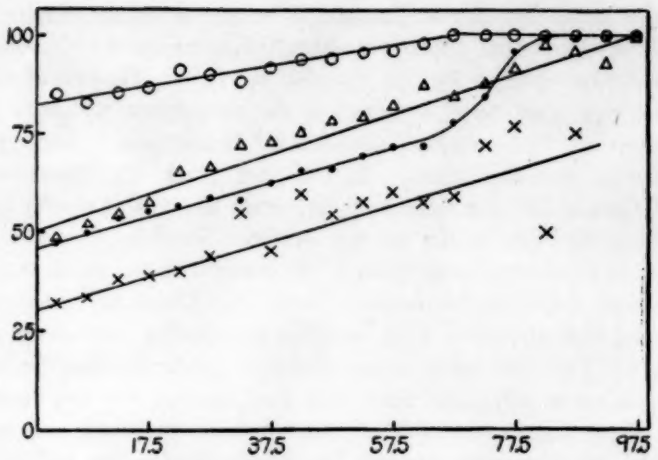

FIG. 1. DEGREE OF INDIAN BLOOD WITH RESPECT TO AGE

Ordinate: degree of Indian blood in per cent. Abscissa: age. The points are placed so at to center five year intervals from 2.5 to 97.5 years. Symbols: solid dots for Group I, circles for Group II, crosses for Group III and triangles for Group IV.

census was taken in 1928 the inference may be drawn that miscegenation began approximately 67.5 years earlier or, say 1860. This is wholly in conformity with the known fact that the Great Basin and Colorado desert tribes made no material contact with the whites prior to the silver rush of 1860 and the Civil War. Subsequent change has been steady and consistent but relatively slow for the mean decrease in Indian blood has been 2.2 per cent per decade.

The history of Group I is strikingly indicated. The youngest category showing full Indian blood is that centering around 82.5 years of age which puts first contact with white men at 1845. In persons between 62.5 and 82.5 years old—i. e. born between 1845 and 1865—there is a tremendous increase in white blood. This corresponds precisely to the pioneer and mining era during which these tribes were nearly destroyed by the inrush of white men. The maximum rate of hybridization seems to have been approximately 18 per cent per decade. After the restoration of stable conditions the rate fell to a constant value which has been maintained ever since—a decrease in Indian blood of 4.7 per cent per decade.

Using a similar index Group IV began to show racial mixture somewhere near 1830. This is puzzling if we remember that the territory was first entered by the Spanish in 1770. However, although intermarriage must have occurred in the subsequent 60 years it does not appear to have reached quantitative importance. This is probably due to several factors. In the first place, the missions south of San Gabriel did not encounter the great mass of Luiseño and Cahuilla until very late in the mission period. Secondly, mission administration as a rule was better than in the north with the result that fewer illicit unions were consummated. Thirdly, the Diegueño and to a lesser extent the Cahuilla were wild, warlike, and highly refractory to mission rule. The real social demoralization of these tribes began with secularization in 1834 and since that time, except for the reservation system there has been little inherent obstacle to miscegenation. As the graph suggests, this process has been effective for the past century, for the rate of decrease in Indian blood with Group IV has been on the average 5.0 per cent per decade.

In Group III the oldest persons may show white blood. Indeed, the categories over 67.5 years of age contain so few individuals and are so erratic that they are of little use in determining the exact trend. However, it is not unreasonable to extrapolate the line backward, since its slope in the past 60 years has been fairly uniform. If this is done, the line crosses the 100 per cent level at the hypothetical age category centering around 152.5 years. The earliest racial mixture would hence appear to have been at or near the year 1775 which is quite in conformity with probability. The whitening of Indian blood among the central and northern missions, therefore, must have begun immediately upon settlement and have continued to the present in a generally uniform manner. By contrast to Group IV these Indians were always peaceable, tractable and easily assimilated socially. Secularization and its attendant disturbance consequently entailed little more than a possible slight acceleration of an already well established process. The mean rate of decrease of Indian blood in recent times, and probably earlier, has been 4.5 per cent per decade.

It will be noted that the mean decennial decrease in per cent Indian blood is very nearly the same in Groups I, III, and IV (4.7, 5.0, 4.5) whereas it is markedly less in Group II (2.2). The difference undoubtedly is referable to the more intense interracial contact which has existed in the coastal and valley strip of California as opposed

to the desert region east of the mountains. Thus, since 1860, the coastal groups have reacted almost identically, irrespective of their previous history.

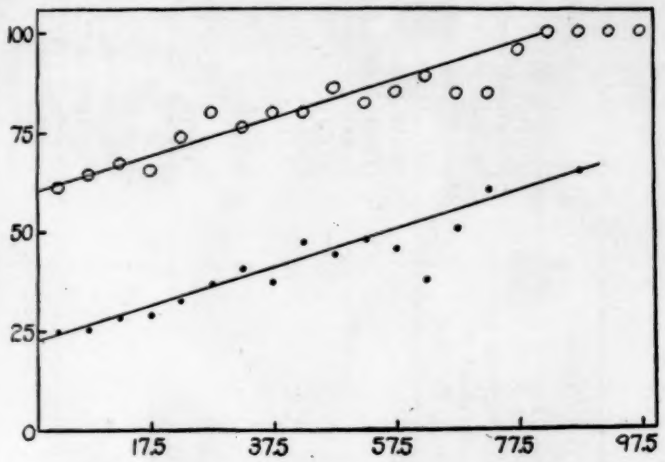

FIG. 2. DEGREE OF INDIAN BLOOD WITH RESPECT TO AGE

Ordinates as in Fig. 1. Solid dots represent the Luiseño, Juaneño, Gabrieleño and Fernandino of Los Angeles and Orange Counties; circles represent the Luiseño and Diegeño of San Diego County.

Fig. 2 is introduced in order to examine more closely the situation in Group IV. Here are two selected stocks: (1) the Gabrieleño, Fernandino, Juaneño, and Luiseño living in Los Angeles and Orange Counties, and (2) the Luiseño and Diegueño living in San Diego County. The former were highly missionized and exposed to heavy social contact from an early date. The latter were particularly intractable and unassimilable during the mission era although they were exposed to Caucasian influence for as long a period. The different reaction is demonstrated in the graph by the much earlier appearance of miscegenation among the Los Angeles County Indians. Indeed, not until nearly 1850 did the San Diego County natives begin to yield to the pressure of the white race.

It is very tempting to extrapolate these data into the future, however dangerous the process, in order to make some prediction concerning the final racial amalgamation of the California Indian. The principal difficulty lies in the assumption, tacit or otherwise, that the

TABLE 3

Comparison of racial and social trends, derived from various sources

RACIAL MIXTURE		FOOD HABITS		MIGRATION		MARRIAGE	
Degree of blood, expressed as per cent Indian blood		Per cent of total diet which consists of aboriginal food stuffs		Per cent of the stock who had migrated from the aboriginal territory by 1928		Per cent of marriages which were legal rather than Indian custom for the period 1880-1940	
Group I	37.7	Maidu	0.3	Group I	15.4	Round Valley Res., Yurok, Karok, Hupa	32.2
Group II	57.4	Nevada and California Paiute and Washo	6.0	Group II	6.3	....	...
		Atsugewi (Pit Rivers)	5.0				
Group III	32.6	....	..	Group III	40.1	....	...
Group IV	42.7	....	..	Group IV	6.5	Old Mission and Cahuilla *	55.2
Group V	57.9	....	..	....	...	Nevada Paiute and Washo	5.2

* The high value here is due to the influence of the Missions and more recently the individual efforts of the Catholic clergy.

present rates will continue unaltered as practical social assimilation is achieved. Furthermore in the ultimate stages the decrease in per cent Indian blood cannot be a linear function of time; it must become exponential and approach the zero value as a limit. In order to simplify, however, we may consider that when an individual has 1/32 Indian and 31/32 white blood, he is in the social sense fully white. Making the further gratuitous assumption that the rates of change in degree of blood will continue as in the past three generations, we may extrapolate the graphs. Starting from the 1928 levels the number of years it will take the four California groups to attain a mean of 3.1 per cent Indian blood for children under 5 years of age is respectively 55, 230, 30 and 65. To achieve reasonable social amalgamation as well as genetic, however, we should use the epoch at which the oldest members reached the designated mean degree of blood. Here we obtain the values, respectively, of 100, 450, 70, and 115 years subsequent to 1928.

Even though the above calculation is admittedly very crude, it is reasonably safe to conclude that if existing conditions do not alter, the cis-montane California Indians will have merged fully with the white race in approximately one century, while the Great Basin and Nevada Indians will not reach that point for nearly five hundred years.

At the beginning of this paper mention was made of progress achieved by the California and Nevada aborigines with respect to various environmental and cultural factors. It was suggested that degree of miscegenation might be concerned in the entire behavior complex. We may now compare certain data in such a way as to emphasize the correspondence. In Table III are brought together the primary results of four distinct lines of investigation, those pertaining to (1) hybridization, (2) food habits, (3) migration, and (4) marriage. The tribes and groups cannot be completely identical nor can the numerical values be correlated in any rigid statistical sense. Nevertheless the overall picture emerges clearly and the conclusion is justified that there is a broad parallelism between adoption of Caucasian customs and mean degree of Indian blood. One cannot be dogmatic with respect to causes but it is possible to affirm that there has been a definite interrelation between environmental and genetic factors in determining the rapidity with which the Indian is assimilated.

* The high value here is due to the influence of the Missions and more recently the individual efforts of the Catholic clergy.

MEAN DIFFERENCES AND INDIVIDUAL DIFFERENCES

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IN experimental studies of individual differences it is not always clearly recognized that a statistical result which holds on the average may have little prognostic value for the individual. Two illustrations will bring out this point more clearly. The actuary is quite certain that from his life expectation tables he can tell how many of 100,000 men aged 30 will live to be 40, and he is equally certain that he cannot predict the life span of a single person. Again, when the correlation between two tests X and Y is .60, we know that 70 percent of those who fall in the upper half of measure X also fall in the upper half of measure Y, but from the regression equation alone we are unable to predict a man's score in Y from his score in X with any assurance.

In the same way, a significant difference between means does not necessarily imply consistent individual differences as among the members of the groups compared. Thus while 10-year-old girls may on the average be significantly superior to 10-year-old boys on a vocabulary test, the experimenter may not be able to tell from a given child's score whether the subject is male or female. It may be, of course, that one's interest does not extend beyond the group result. But at the same time it must be recognized that an average difference does not necessarily hold for each individual, and it should be known further under what conditions one is justified in going from mean to individual differences. This is the problem of this paper.

Suppose that a statistically significant difference has been established between the means of two groups A and B; and that care has been exercised to make A and B representative of their respective populations. Before accepting this mean difference as being useful

or important for individual prognosis, we must consider the following facts with reference to the two distributions:

(1) the absolute size of the difference;

(2) the range of measures within the two groups being compared;

(3) the degree of overlap;

(4) the standard error of single measures within the two distributions.

Data recently published by Pearl and Moffet* illustrate concretely the distinction between statistically significant mean differences and practically non-significant individual differences. In studying the problem of the relation of certain bodily measurements to longevity, Pearl and Moffett gathered statistics from the life insurance examinations of 2332 adult white males (all now deceased). Two groups were assembled, the one called the "long-lived", the other the "short-lived" group. The long-lived group consisted of those men who were the longest lived in their cause-of-death group; the short-lived were the shortest lived in their cause-of-death group. Six cause-of-death groups were set up. We shall deal here only with the 1600 men who died of heart and circulatory disease (800 being classified as long- and 800 as short-lived) since these men constitute the largest single cause-of-death group. The essential figures for the groups are as follows:

	N	*Age at observation*	*Age at death*
Long-lived	800	41.69±.29	76.73±.12
Short-lived	800	41.30±.27	51.91±.23

It is clear that these two groups—although almost exactly the same age when examined for life insurance—were markedly unlike as regards survival. In their initial bodily measurements the two groups were found to have differed significantly in body-weight and probably in chest and certain other measures. Particular importance, however, seems to have been attached by Pearl and Moffett to differences between the two groups in pulse-rate. The data on pulse-rate are as follows:

* Pearl, R., and Moffett, W. E. Bodily constitution and human longevity. *Proc. Nat. Acad. Sciences*, 1939, 25, 609-616.

	Long-lived (N=798)	*Short-lived (N=798)*
Mean	72.85 beats per min.	74.38 beats per min.
SD	4.61 *	4.19 *
PE_M	.11	.10

Difference between Means = 1.53 PE (Difference) = .15 CR = 10.2

* Pearl and Moffett report only PE_M's. The SDs were calculated by use of the formula $PE_M = \frac{.6745\ SD}{\sqrt{N}}$.

Statistically the difference in pulse-rate is highly significant—the CR is 10.2. Because of their faster heart rate, our authors calculate that up to the age of 40 years the heart of a short-lived man has beaten some 18,000,000 times more often than has the heart of a long-lived man. This greatly increased cardiac labor, they suggest, parallels a faster rate of living and this in turn is the forerunner of early breakdown. Pulse-rate, then, becomes an important diagnostic sign of probable length of life. This conclusion has been reported in the newspapers with various embellishments, warnings, etc.

In spite of the impressive critical ratio, the average difference in pulse-rate found by Pearl and Moffett is not "really" significant in the sense of being diagnostic of longevity in a given individual. Let us consider the "tests" given above.

(1) The absolute size of the difference is small, about 1.5 beats per minute. It is well-known that many factors (breathing rate, emotion, time-of-day, previous activity, smoking and others) affect pulse-rate. These influences usually average out, and may be considered as "chance errors" but we have no way of knowing whether some of these factors were present in one group more often than in the other, and hence were really constant errors. While not probable, this is a possible source of error.

(2) The range of pulse-rates in the long-lived group is from about 87 to 59 beats per minute; in the short-lived group from 87 to 61 (assuming normality in both groups). Thus the two groups cover almost exactly the same range.

(3) The degree of overlap is quite large. Slightly more than 37 percent of the long-lived equal or exceed the mean of the short-lived in pulse-rate. If 100 men were selected at random from the long-lived group, approximately 40 would have pulse-rates as high as or

higher than the mean pulse-rate of the short-lived. Of 100 men selected at random from the short-lived group, about 36 would have pulse-rates lower than the mean rate for the long-lived.

(4) The standard error of a pulse-rate determination is not given, nor have we any measure of the reliability of pulse-rate readings. It is probable, however, that such reliability is not high; in fact, it may be quite low. Many life insurance examiners count the pulse for 20 seconds and multiply by 3, thus exaggerating any error which may have been made. Again, unless the pulse-rate is manifestly very high or very low, no effort is made, ordinarily, to determine it exactly. Assuming the repeat reliability in either group to be .80 (a very generous estimate) the standard error of a pulse reading is around 2 beats per minute. Thus a man's "true" pulse-rate might differ by as much as ± 6 from the figure reported; and this variability makes the differentiation of individuals into two groups uncertain.

The clear implication from these data seems to be that while the obtained CR has actuarial value it has negligible diagnostic significance for the individual. If we could examine the pulse-rates of 100,000 men all of whom are destined to die of heart and circulatory disease, it appears certain from our data that the shorter-lived men would on the average have the faster pulse-rates. But the difference would doubtlessly be small, and the pulse-rate of a given individual well-nigh worthless as a predictor of length of life.

We may summarize our discussion as follows:

1. The CR yields important and definite information, but there is real danger that we may read into a significant difference more than is justified. The generalization given by the CR is in terms of probability and rests upon definite assumptions. The most important of these assumptions is that of adequate sampling. Unless our groups are representative of their populations (being random or stratified samples, say,) we cannot pass from sample to population.

2. Generalization with regard to mean difference may be worth very little when individuals are to be compared. In evaluating a significant difference for individual prediction the following factors must be considered:

(1) The absolute size of the mean difference. This may be so small as to be psychologically, physiologically, or socially of little consequence.

(2) The range of measures within the two groups being compared. Often the range within either group is so much greater than the typical (i. e. mean) difference between the groups as to minimize the latter. Moreover, the range may have almost identical limits in the two groups.

(3) The degree of overlap. We may find that 40 percent or more of the lower group equal or exceed the mean of the upper group. In such situations it is almost impossible to place a given individual reliably within either group. One might set up, as a criterion for individual differentiation, the requirement that not more than 25 percent of the lower group reach or exceed the mean of the upper group. Or for some purposes an even more stringent standard might be established, depending upon the purpose of the experimenter.

(4) The standard error of a single measure depends upon the reliability of the individual determinations. Such reliability, of course, should be as high as possible, if individual measures are to be differentiated.

BIRTH-ORDER AND HEART RATE IN CHILDREN

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WHILE carrying out a series of investigations which deal primarily with problems of health and disease in familial aggregates, data resulting from the stethographic examination of school children have been examined. An unexpected relationship between the order of birth of the child and the duration of the cardiac cycle has thus been discovered and is here reported.

The material studied consists of stethograms made in the spring of 1940 of the student population of an elementary school of Hagerstown, Maryland. All the children at the time enrolled in the school were examined with the exception of a few who were absent continuously during the survey period. The total number examined was 778 (400 boys and 378 girls). The examination procedures, and the method of measuring the duration of the cardiac cycle and its components are those employed in an earlier survey already reported.[1]

The Hagerstown family rosters of the Child Hygiene Office have provided the necessary information regarding order of birth. In these rosters are also contained the number and sequence of the officially recorded abortions and stillbirths as well as the live births that have occurred to the mothers of the children. In the present study, therefore, *order of birth* has essentially the same meaning as *order of pregnancy*.

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[1] Boone, Bert R. and Ciocco, Antonio. Cardiometric studies on children. I. Stethographic patterns of heart sounds observed in 1,482 children. *The Milbank Memorial Fund Quarterly*. XVII, No. 4, October, 1939, pp. 323-357. Boone, Bert R., and Ciocco, Antonio. Cardiometric studies on children. II. The duration of the component parts of the cardiac sound cycle. *The Milbank Memorial Fund Quarterly*. XVIII, No. 2, April, 1940, pp. 137-155.

TABLE 1

Birth-order and duration of cardiac cycle, systole, and diastole, in seconds

AGE (*in years*)	BOTH SEXES				BOYS				GIRLS			
	Birth-orders 1 and 2		*Birth-orders 3+*		*Birth-orders 1 and 2*		*Birth-orders 3+*		*Birth-orders 1 and 2*		*Birth-orders 3+*	
	Number	Mean and probable error	Number	Mean and probable error	Number	Mean and probable error	Number	Mean and probable error	Number	Mean and probable error	Number	Mean and probable error
						Cardiac cycle						
6-7	120	.644 ± .008	83	.689 ± .010	55	.648 ± .013	38	.700 ± .014	65	.640 ± .009	45	.680 ± .013
8-9	133	.727 ± .007	99	.743 ± .009	66	.757 ± .010	51	.755 ± .012	67	.695 ± .010	48	.731 ± .012
10-11	122	.727 ± .007	79	.745 ± .007	60	.756 ± .011	40	.784 ± .011	62	.699 ± .009	39	.705 ± .009
12+	72	.757 ± .009	70	.776 ± .011	43	.769 ± .011	47	.811 ± .013	29	.739 ± .014	23	.705 ± .011
All ages	447	.709 ± .004	331	.737 ± .005	224	.732 ± .006	176	.764 ± .007	223	.687 ± .005	155	.705 ± .006
						Systole						
6-7	120	.292 ± .002	83	.303 ± .002	55	.291 ± .003	38	.299 ± .003	65	.295 ± .003	45	.307 ± .003
8-9	133	.308 ± .002	99	.311 ± .002	66	.312 ± .002	51	.311 ± .003	67	.304 ± .003	48	.309 ± .003
10-11	122	.307 ± .002	79	.313 ± .002	60	.311 ± .002	40	.319 ± .002	62	.303 ± .002	39	.308 ± .002
12+	72	.316 ± .002	70	.313 ± .002	43	.315 ± .002	47	.317 ± .003	29	.316 ± .004	23	.304 ± .003
All ages	447	.304 ± .001	331	.309 ± .001	224	.307 ± .001	176	.312 ± .001	223	.303 ± .001	155	.308 ± .001
						Diastole						
6-7	120	.351 ± .006	83	.387 ± .008	55	.360 ± .011	38	.402 ± .012	65	.343 ± .007	45	.374 ± .011
8-9	133	.418 ± .006	99	.430 ± .007	66	.446 ± .009	51	.440 ± .010	67	.390 ± .008	48	.318 ± .010
10-11	122	.419 ± .006	79	.435 ± .007	60	.446 ± .010	40	.471 ± .010	62	.394 ± .007	39	.396 ± .008
12+	72	.446 ± .007	70	.464 ± .009	43	.458 ± .009	47	.492 ± .012	29	.427 ± .011	23	.406 ± .010
All ages	447	.404 ± .003	331	.427 ± .004	224	.427 ± .005	176	.452 ± .006	223	.382. ± .004	155	.398 ± .005

The main findings on the observed relationship between birth-order and the cardiac cycle are summarized in Tables 1 and 2. From Table 1 it is noted that:

1. Combining all ages and both sexes, children of birth-orders 1 and 2 have a statistically significantly shorter cardiac cycle, diastole, and systole than do children of birth order 3 or higher.

2. The shorter duration of the cardiac cycle and diastole of the children of birth-orders 1 and 2 is observed for each of the separate age groups and is most marked in the children 6 or 7 years old. For all age groups except "12 and over" the duration of systole is also less in the children of birth-orders 1 and 2.

3. The differences between the birth-order groups compared are greater among boys than among girls. The duration of cardiac cycle, systole, and diastole respectively, is shorter in all the boys of birth-orders 1 and 2 except in those aged 8 or 9 years, and in all the girls of the same birth-order except in those of 12 years and older. In the case of the girls there is apparent a tendency for the differences between birth-orders 1 and 2 and birth-order 3 or higher to decrease with increasing age.

TABLE 2

Birth-order and heart rate

AGE (*in years*)	MEAN HEART RATE (*beats per minute*)					
	Both sexes		*Boys*		*Girls*	
	Birth-orders		Birth-orders		Birth-orders	
	1 and 2	3+	1 and 2	3+	1 and 2	3+
All ages	84.6	81.4	82.0	78.5	87.3	85.1
6-7	93.2	87.1	94.5	85.7	93.8	88.2
8-9	82.5	80.8	79.3	79.5	96.3	82.1
10-11	82.5	80.5	79.4	76.5	85.8	85.1
12+	79.3	77.3	78.0	74.0	81.2	85.1

When the duration of the cardiac cycle is expressed in terms of heart beats per minute (heart rate = 60/cycle duration), Table 2 reveals that on the average children of birth-orders 1 and 2 have a heart rate 3 beats per minute faster than children of the higher birth-

orders. The difference between the two birth-order groups is 3.5 beats per minute in the case of boys and 2.2 for girls. In the age groups 6 and 7 years it is 8.2 and 5.3 beats per minute for boys and girls respectively.

These findings apparently point to some influence of the maternal status during pregnancy—or possibly of either the maternal or paternal conditions at impregnation—on the growth and development of the cardiovascular system of the offspring. The precise significance of the observations depends upon whether the differences between children of low and those of high order of birth disappear with increasing age (as the data on the girls would tend to indicate), or are maintained throughout adult life.

NOTES

FURTHER NOTE ON THE DEATH RATE AMONG OLD-AGE ASSISTANCE RECIPIENTS IN RHODE ISLAND

IN a note in HUMAN BIOLOGY for September 1942, R. R. Willoughby presented data on death rates for the old-age assistance population and the aged general population in Rhode Island. Rates for the general population were computed for 1939 on the basis of the 1940 population as shown by the Sixteenth Census and on the basis of a stated number of deaths among those over 65 in the calendar year 1939 (1785 males and 1848 females).

These general population death rates may be improved by two modifications; first, the exposure should be on the basis of the population as of the middle of 1939 rather than as of April 1, 1940, and second, the stated number of deaths used by Willoughby do not agree with those published by the Bureau of the Census in *Vital Statistics—Special Reports, Summary of Vital Statistics, Rhode Island, 1939.* Vol. 10, No. 4, December 3, 1940, where there are shown to be a total of 1929 male deaths and 2054 female deaths at age 65 and over.

In the accompanying table there are set down the exposure and deaths on this improved basis (with the method of derivation of the exposure being explained in footnote "b" thereof). There are also compared the rates for the old-age assistance population as derived by Willoughby for the period 1938-41. In general, old-age assistance mortality appears to be lower than that of the general population. For purposes of consideration there are also set down the aggregate death rates for the two populations which, as may be seen, are not valid comparisons because the differences in the age distribution produce a slightly higher aggregate rate for the old-age assistance group even though it has lower rates at most ages. Instead the death rates should be standardized on the basis of the same population age distribution.

TABLE 1

Calculation of population mortality rates for those over age 65 in Rhode Island, 1939, and comparison with rates for old age assistance recipients [a]

AGE GROUP	TOTAL POPULATION			OAA Rate [a]	RATIO OF OAA TO TOTAL RATE (*Per cent*)
	Exposure [b]	Deaths [c]	Rate		
		Males			
65-69	10,419	502	.048	.0581	121
70-74	7,135	538	.075	.0638	85
75-79	3,831	429	.112	.0944	84
80-84	1,662	292	.176	.1319	75
85+	756	168	.222	.2614	118
Total	23,803	1,929	.081	.0834	103
		Females			
65-69	12,296	473	.038	.0386	102
70-74	8,485	531	.063	.0536	85
75-79	4,933	443	.090	.0780	87
80-84	2,441	350	.143	.1126	79
85+	1,251	257	.205	.1886	92
Total	29,406	2,054	.070	.0695	99
		Total persons			
Total	53,209	3,983	.075	.0756	101

[a] From Willoughby, R. R.: Note on the death rate among persons receiving old-age assistance in Rhode Island. HUMAN BIOLOGY, 14: 3-386, 1942.

[b] Estimated aged population as of middle of 1939 (straight line interpolation of 1930 and 1940 censuses to obtain age groups 65-69, 70-74, and 75+ separately by sex and then last age group further subdivided on basis of percentage distribution of 1930 census for those aged 75+).

[c] From Bureau of the Census. *Vital Statistics—Special Reports, Washington, D. C. Summary of Vital Statistics, Rhode Island, 1939.* Vol. 10, No. 4, December 3, 1940.

Thus there may be computed the "expected" deaths in the general population resulting from applying to this exposure the old-age as-

sistance death rates, and the results then compared with the actual number of deaths. This has been done for men and women separately by merely accumulating the products of the second and fifth columns of the accompanying table with the following results:

	Actual deaths	*"Expected" deaths*	*Ratio (Percent)*
Men	1,929	1,839	105
Women	2,054	1,825	113
Total.....	3,983	3,664	109

This indicates that old-age assistance mortality is about 10 percent lower than general population mortality for the limited sample under consideration.

Statistical tests indicate that there is a significant difference present between general and old-age assistance death rates despite the rather small populations involved. However, there are several disturbing factors which do not permit the conclusion to be drawn that the mortality of persons receiving old-age assistance is more favorable than that of the general population. First, the rates for the two groups cover different periods of time. Second, there are present such customary but indeterminate censal errors as under-reporting of deaths, misstatement of age, etc. Third, and perhaps most important, is the fact that persons are removed from the old-age assistance rolls if they enter a public institution. In Rhode Island, between July, 1937 and July, 1940, the number of cases closed because of admission to an institution were almost ½ as large as the number of deaths (actually 43% as calculated from *Social Data on Recipients of Public Assistance* published annually by the Social Board). This relatively large number of withdrawals from exposure (most, presumably, being in poor health) would tend to introduce a considerable bias in a mortality investigation since there would be a considerable tendency for only the better lives, from a mortality standpoint, to be left on the rolls and expose to risk of death. The favorable differential of old-age assistance mortality is thus more apparent than real; it would be expected that the opposite situation would occur because of the less favorable economic status of this group. If it were possible to make a mortality investigation of all cases accepted following through until

their ultimate deaths, regardless of then being on the rolls, a differential in the other direction would probably show up.

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* Opinions expressed in this article are those of the author, and do not necessarily reflect the official views of the Social Security Board.

RECENT LITERATURE

USEFUL IN THE STUDY OF HUMAN BIOLOGY

In this department will be noticed the books and reprints which are currently received at the Editorial Office. Publications intended for notice here should be addressed to Dr. Lowell J. Reed, Editor of Human Biology, 615 North Wolfe Street, Baltimore, Maryland, U. S. A.

I. EVOLUTION AND GENETICS

1. *Evolution — General Principles*

DRESCHER, ARTHUR B., E. L. FURLONG, IDA S. DEMAY, PAUL C. HENSHAW, ROBERT W. WILSON, HILDEGARDE HOWARD, and G. H. R. VON KOENIGSWALD. Studies of Cenozoic Vertebrates of Western North America and of Fossil Primates. *Contributions to Paleontology Carnegie Institution of Washington, Publication* 530. *Washington, D. C.* (Carnegie Inst.), 1942. Pp. 222 + 31 plates. 9¾ × 6⅞ inches. $2.25 (paper); $2.75 (cloth). [Bibliography or bibliographic footnotes for each paper.]

MAYR, ERNST. Systematics and the Origin of Species from the Viewpoint of a Zoologist. *New York* (Columbia Univ. Press), 1943. Pp. xiv + 334. 9 × 5¾ inches. $4.00. [Bibliography of 16 pages.]

2. *Human Evolution*

[Vacant]

3. *Prehistory and Archaeology*

CHILDE, GORDON. Prehistory in the U. S. S. R. II. The copper age in South Russia. *Man*, 42: 130-132, 1942.

DANIEL, JOHN FRANKLIN. Social continuities in Cyprus. *Scient. Monthly*, 56: 78-80, 1943.

HOAGLAND, CLAYTON. They gave life to bones. *Scient. Monthly*, 56: 114-133, 1943. [12 bibliographic footnotes.]

STEWART, GUY R., and MAURICE DONELLY. Soil and water economy in the Pueblo Southwest. I. Field studies at Mesa Verde and northern Arizona. *Scient. Monthly*, 56: 31-44, 1943. [11 bibliographic footnotes.]

STEWART, GUY R., and MAURICE DONNELLY. Soil and water economy in the Pueblo Southwest. II. Evaluation of primitive methods of conservation. *Scient. Monthly*, 56: 134-144, 1943. [22 bibliographic footnotes.]

STRATTON, C. G. The older drift of Wisconsin. *Scient. Monthly*, 56: 45-49, 1943.

4. *Genetics — General Principles*

FORD, E. B. Genetics for Medical Students. *London* (Methuen and Co.,), 1942. Pp. 162. 7¼ × 4¾ inches. 7s. 6d. [Bibliography of 3⅓ pages.]

5. *Human Heredity*

STEGGERDA, MORRIS. Inheritance of short metatarsals. *J. Hered.*, 33: 233-234, 1942. [Bibliography of 3 titles.]

STEGGERDA, MORRIS. Significance of racial factors in physical measurements of normal or defective children. *Am. J. Ment. Deficiency*, 46. 1942. Pp. (of reprint) 3.

WHITNEY, DAVID D. Family Treasures: A Study of the Inheritance of Normal Characteristics in Man. *Lancaster* (Jaques Cattell Press), 1942. Pp. 299. 9¾ × 6¾ inches. $3.50. [Bibliography for each chapter.]

6. *Eugenics*

[Vacant]

II. GROUP BIOLOGY

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